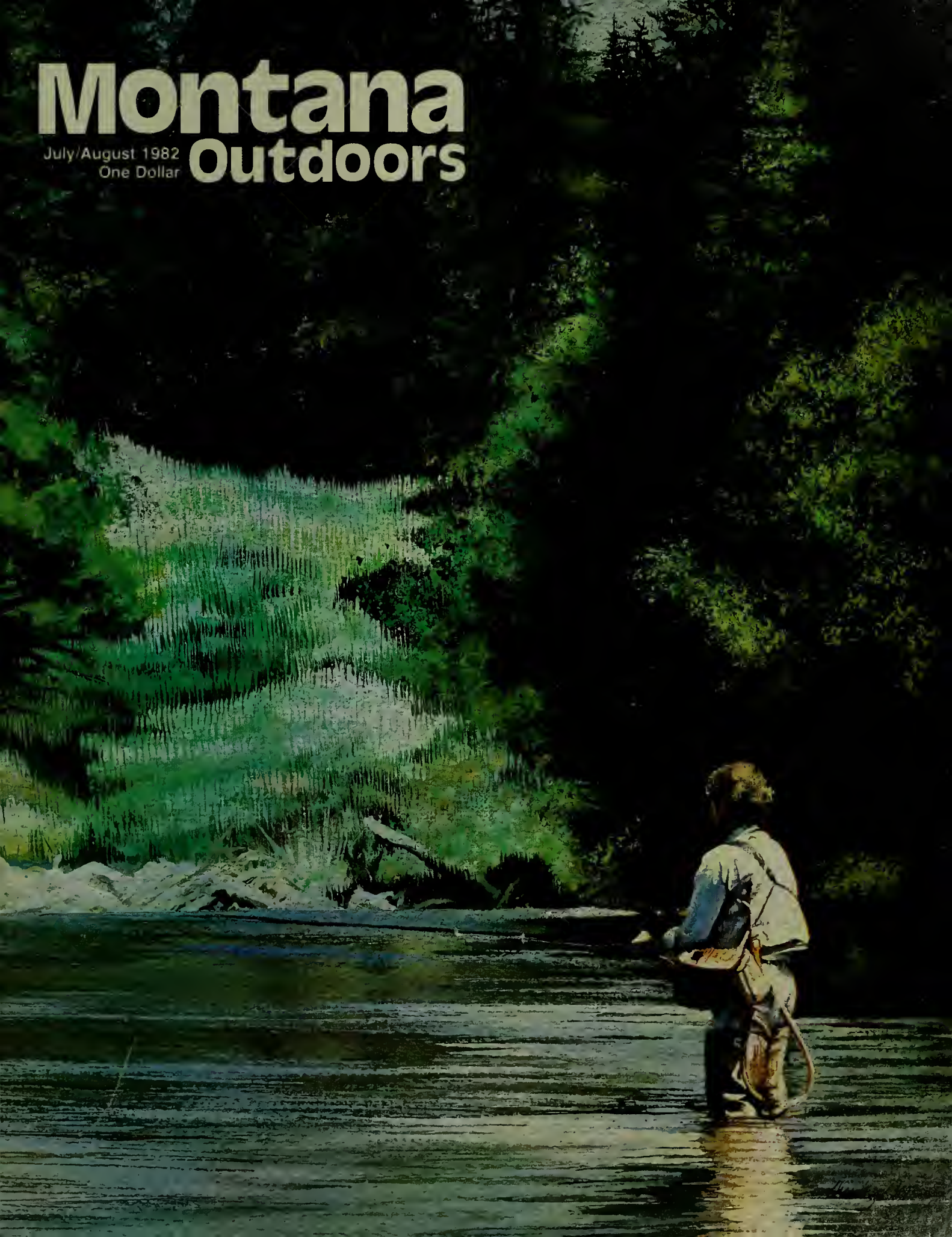
# Montana Outdoors

July/August 1982
One Dollar



Orthocarpus

# Montana Outdoors

July/August 1982, Vol. 13, No. 4
(USPS 360 280)

**Front Cover**
Montana's hard-to-beat fishing opportunities beckon to anglers of all ages and persuasions. Shirley Cleary's painting illustrates the appeal of one of the most popular: fly fishing.

**Inside Front Cover**
Larry Thompson's rendition of the colorful *Orthocarpus* explains why it attracted the eye of Meriwether Lewis in 1806. Lewis gathered it near what is now Lolo Creek in Missoula County.

**Back Cover**
Kendahl Jubb's stylized and vibrant watercolor is aptly titled, "Kokanee in Motion."

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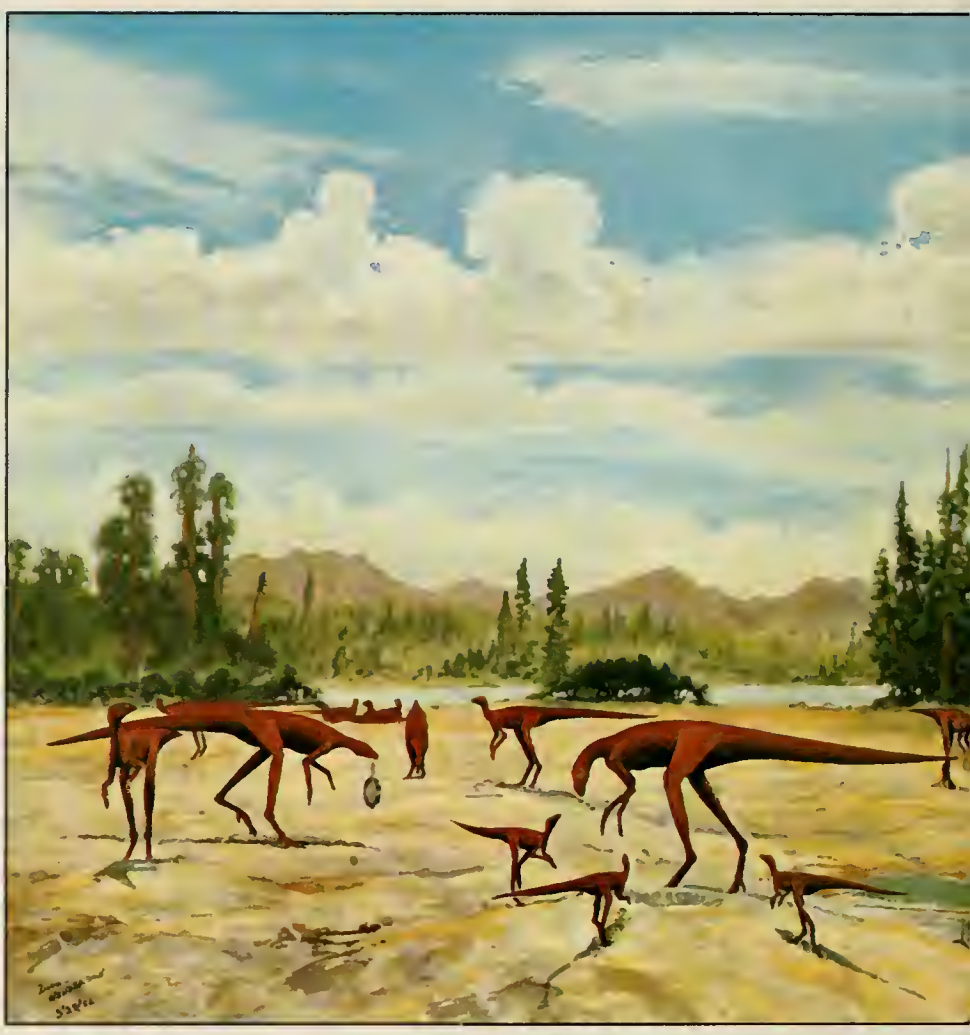
# Coming Home To Roost



## by Jack Horner
## illustrated by Doug Henderson

*Eggs, babies, embryonic bone, and juveniles and adults of several different types of dinosaurs—one of the world's most important dinosaur sites is here in Montana! Although it will take years to excavate the site and prepare the bones for public viewing, this exciting task is well under way. When completed, the story will unfold in a new paleontology museum at the Museum of the Rockies in Bozeman. John R. "Jack" Horner, formerly of Princeton University, has been hired by Montana State University to research, collect, and prepare fossils for the unique exhibits which will be featured in the new museum.*

*Horner and I recently received a $15,000 grant for an "Analysis of a Dinosaur Ground and Its Inhabitants." Funds were received from the MONTS (Montanans On a New Track for Science) program, a National Science Foundation project directed by Dr. Gary Strobel of MSU.*

*Research objectives include the collection of dinosaur nests, eggs, hatchlings, and adults near Choteau, and the interpretation of the site, including the nesting patterns of several species of dinosaurs, growth changes, and species variation within large samples of dinosaurs. Other goals include a more complete identification of the dinosaur fauna, determination of parent-juvenile relationships and juvenile mortality rates, and the collection and identification of related animals.*

*The story that follows traces the history of this most important site and paints a bright new picture for interpretation of our geologic heritage here in Montana.*—Dr. Michael W. Hager, director, Museum of the Rockies

* * * * *

DURING spring 1978, Marion Brandvold and David and Laurie Trexler of Bynum, Mont., were prospecting for dinosaur bones on the James and John Peebles Ranch west of Choteau. Marion stopped to rest and, while waiting for David and Laurie to return, began picking up small bone fragments that littered the top of a little hill. When the Trexlers returned, they helped collect and by the end of the day, the group had enough fragments to fill a large coffee can. Although they were not sure what they'd found, they took the collection home and tried to fit some of the pieces together.

For Bob Makela, a high school science teacher from Rudyard, and I, the summer of 1978 was much like the 10 preceding summers. We were exploring and collecting dinosaur remains along the Canadian border north of Rudyard. At the end of July, we were asked by Bill Clemens of the University of California at Berkeley to stop by Bynum for a look at a large dinosaur collected by some people who owned a rock shop—the Trexlers and Marion Brandvold. We visited the Trex Agate Shop in Bynum where we met Marion and were shown a number of dinosaur specimens.

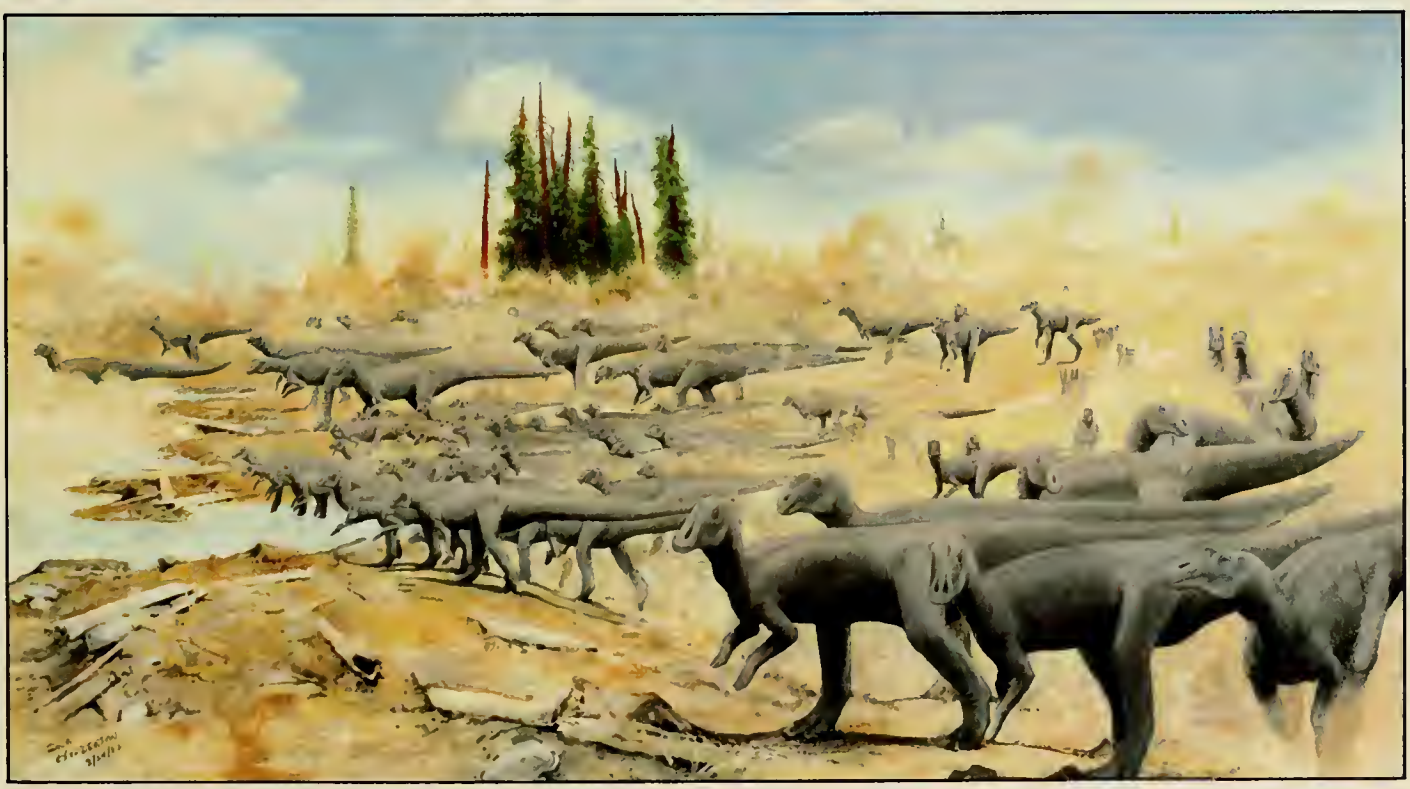
After identifying these specimens for her, she asked if we would iden-

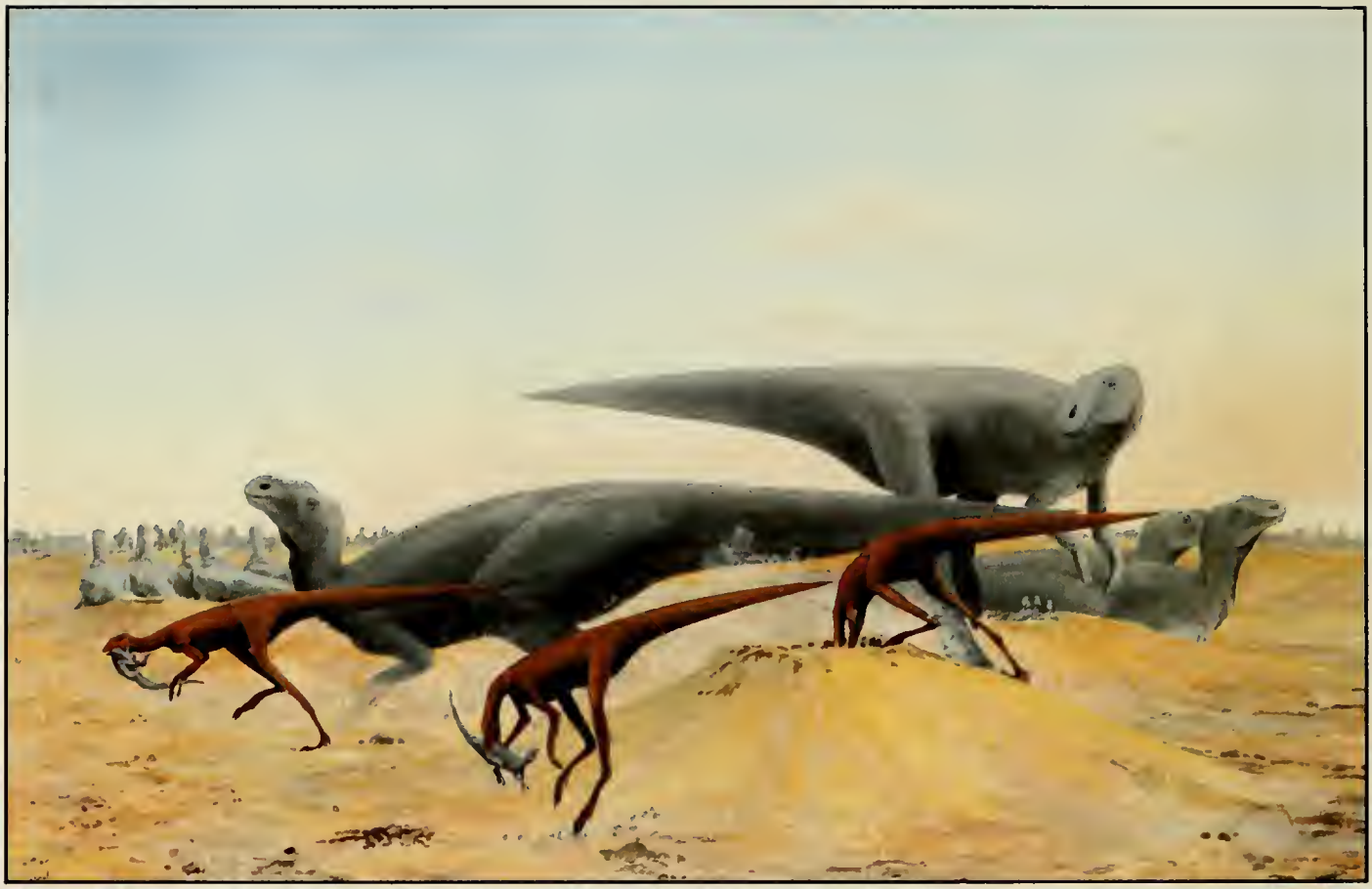
Carnivorous, or meat-eating, dinosaurs (left) were much smaller and faster than the duck-billed dinosaurs depicted below. The adult duckbills, shown protecting their young on the way to a feeding area, were 30 feet long and weighed about three tons.

tify some other small bones. She handed us two pieces, each about an inch long. A few moments later, I turned to Bob and said, "You're not going to believe this, but I think these are pieces of a baby duck-billed dinosaur." Although Bob was very skeptical—and rightfully so, since neither of us had seen a baby dinosaur bone in 10 years of collecting—he, too, became convinced after we examined the other pieces. We explained to Marion, David, and Laurie that the specimens were of great scientific importance and they turned over the specimens to us and later showed us the area from which they had been collected.

In the following days, Bob and I excavated the site and removed 15 babies from what appeared to have been the remains of a fossilized nest.

A week later, Laurie made another important discovery when she found the skull of a new kind of duck-billed dinosaur that has since been named *Maiasaura peeblesorum,* in honor of





**Fast-moving carnivorous dinosaurs are portrayed here raiding a duck-billed dinosaur nest and carrying off the young.**

the Peebles families. The final discovery of 1978, from the same area, was made by Amy Luthin Guthrie (step-daughter of noted Montana writer A.B. Guthrie) who found what has since been determined to have been the remains of a second nest of baby duckbills.

After acquiring permission from the Peebles families to continue exploration and collecting on their land, we initiated an intensive research project. Begun in 1979, this project has to date provided scientists more insight into the social structure of dinosaurs than any other site in the world.

From the information collected in the past four years, we now have evidence that dinosaurs nested in extensive colonies—as do some recent birds and crocodiles. The duck-billed dinosaur nests were six feet in diameter and contained about 20 eggs. Since the parent duckbills were nearly 30 feet long and weighed about three tons, it is obvious that the dinosaurs did not sit on the eggs to incubate them. We assume the dinosaurs placed vegetation over the eggs and that warmth was provided when the vegetation began to ferment. Babies up to about five feet long are found in the nests, suggesting that after they hatched, the young were cared for by the parents until they were several months old. Food—such as berries, seeds, and leaves—must have been brought to the nests by the parents.

A newly hatched duckbill was less than 14 inches long and weighed about one and one-half pounds. Evidence from their bone structure indicates they grew very rapidly, more rapidly than is typical for a cold-blooded animal. This assumed rate of growth, together with the fact that they were apparently cared for, indicates that at least these kinds of dinosaurs were warm-blooded, like birds and mammals.

We have found juvenile dinosaurs over five feet long in association with adults and therefore assume that once they reached approximately this length, they were able to leave the nest and forage for food, with their parents and in the protection of a herd. Some of the herds may have comprised several hundred individuals.

Another kind of dinosaur found in this area, called a hypsilophodont, also nested in colonies but, unlike the duckbills, apparently did not raise its young in the nests. Hypsilophodonts laid about 25 eggs, each of which was carefully pushed into the mud so that only the top half of the egg was visible. Vegetation was probably used for incubation in this species as well, since adults were about eight feet long. The young hypsilophodonts hatched through the tops of the eggs, leaving the bottom half in the nest, undisturbed. The parents may have gathered the babies from all of the nests into groups to take them to forage for food very soon after hatching.

Although much of the information we have been gathering is to determine how dinosaurs lived and interacted, we have also learned a great deal about how some of them died. For example, one deposit contains the remains of an estimated 100 adult and juvenile duckbills apparently killed in a massive volcanic mud slide similar to the recent Mount St. Helens flow.

Isolated carnosaur (meat-eating dinosaur) teeth found with the duckbill remains suggest that some of the corpses were scavenged. At other sites, dinosaurs appear to have been killed by predators, while others, such as the babies in nests, may have starved following the deaths of their parents.

Although it may seem that the specimens and data from this area are easily retrieved, that is far from the case. To gather this kind of information, each site must be carefully mapped and studied while most of the skeletal and egg remains are *in situ* (in their original places). Hasty removal could easily destroy valuable information which could not be reconstructed.

As you read this, we will be collecting more information to determine whether our theories of nesting are correct, and we will also attempt to identify some of the rare species. This year—and in those to follow—the specimens will remain in Montana where they will be studied and displayed at the Museum of the Rockies. With the information and specimens gathered from the Choteau area, we will soon be able to tell an 80-million-year-old story about a few creatures that once inhabited Montana's outdoors. ■

**Dinosaur sleuths: Pictured left to right are Rudyard science teacher Bob Makela; his son Jay; Jack Horner, curator of paleontology, Museum of the Rockies, and Mike Hager, director, Museum of the Rockies. Jay Makela is pointing to a nest of dinosaur eggs he discovered, and Hager is holding a cast of a small nest of eggs (photo: Don Pilotte, Publications and News Service, Montana State University). Portrayed below in Doug Henderson's painting is a duck-billed dinosaur nesting ground.**

Georgetowo Lake near Anaconda is one of the most popular recreational waterways in the state. But Georgetown has a history of problems with an overabundaace of water weeds (photo: Jerry Maoley).

# Of Water, Weeds and Man

## by Paul Garrett

MOST OF us refer to them as "water weeds," often preceded by several expletives—especially if they happen to foul our hooks as we are fishing, or entwine themselves around our propellers and interfere with our boating. In spite of these obnoxious aspects, aquatic macrophytes are an integral part of the aquatic environment. They perform many important, beneficial functions, the most obvious of which are the production of food for waterfowl and cover for fish.

The question involving aquatic macrophytes is usually: How many are enough, without being too many?

Literally defined as "large water plants," aquatic macrophytes comprise a wide spectrum of plant species visible to the naked eye. Most have specialized conducting tissues which carry inorganic nutrients obtained from soil and water, and organic compounds synthesized by the plant itself, from one part of the plant body to another. These are more properly called "vascular hydrophytes."

Some kinds of algae form many-celled organisms resembling higher plants and these are included in the general term. Examples in Montana lakes are *Chara,* often called muskgrass because of its distinctive odor, and *Nitella,* recognizable by the whitish bands around the stems.

Common submerged macrophytes in Montana include the pondweed family (*Potamogeton* genus), which includes over 20 species; watermilfoil (*Myriophyllum exalbescens);* coontail (*Ceratophyllum demersum);* water buttercup (*Ranunculus aquatilis),* and elodea (*Elodea canadensis).* Water weeds of some type occur in almost all aquatic habitats and what kind depends on the type of soil; depth, mineral content, and clarity of water; current speed, and seasonal variations in water levels.

Most water weeds are rooted in the soil and obtain mineral nutrients from it, as opposed to algae which must obtain nutrients from dissolved substances in the water. Research shows that many species of water weeds obtain from 70% to 90% of their mineral needs from the soil, depending on the soil type and mineral concentrations in the water. Rocky, coarse gravels or poor, sandy soils are much less conducive to growth of rooted aquatic plants than fine, rich sediments, which have more available minerals and allow easy penetration of root systems. A few macrophytes, such as coontail, have poorly developed root systems and take most of their nutrition from the water. Others, such as duckweed (*Lemna* genus), are free-floating and have vastly reduced root systems. It isn't surprising that these species are often indicators of cultural eutrophication, with which high concentrations of dissolved inorganic nutrients are associated.

Clarity of the water influences macrophyte growth by regulating the intensity of available light. Aquatic plants are limited at a light intensity lower than or equal to, or slightly less than, 5% of the average light intensi-

In many locations on Georgetown Lake, water weeds such as big-leaf pondweed now cover up to 70% of the lake's surface area. In spite of some of their negative attributes—such as becoming entwined around the propellers of outboard motors—water weeds provide food and cover for both waterfowl and fish (photos: Paul Garrett).

ty at the water's surface. This usually occurs at depths between five and 20 feet, although light penetrates some very clear lakes (such as Yellowstone) to allow growth at depths up to 30 feet.

Water turbidity, which limits light penetration, may be due to plankton algae, sediment, or dissolved substances. Suspended sediment affects rooted aquatic plants by reducing light penetration and by smothering young plants as it settles out.

In some cases, sediment deposits provide a rich habitat for rooted plant growth, demonstrated by the diked dust control ponds at Canyon Ferry Reservoir near Townsend. Water levels and flow are controlled in these ponds by headgates, which maintain adequate depth and water clarity and allow abundant plant growth on the silt deposits laid down by the river. This has created excellent feeding areas for waterfowl.

Other factors influencing rooted aquatic plants are current speed and water level fluctuations. In rivers, current speed affects plant distribution both by direct mechanical action on the leaves and stems, and by influencing the nature of the bottom. Faster currents can move larger soil particles; thus, the finer-grained soils conducive to macrophyte growth are only present in deeper, slower moving reaches.

Obviously, water weeds require water in which to grow. Many reservoirs are operated with drastic fluctuations in water levels from season to season which largely eliminates rooted aquatic plant communities.

Aquatic macrophytes reproduce by various means, including flowering, production of overwintering buds which lie dormant through the winter then initiate growth in the spring, or vegetative growth of new stems from roots, rhizomes, or stem fragments. The ability to reproduce vegetatively confers important growth advantages on some water weeds enabling them to spread rapidly into new areas. This is true of Eurasian water-milfoil, a serious pest in much of the United States and parts of Canada. Introduced from Europe to the East Coast, in about 30 years it has spread to the Pacific Coast, infesting many lakes, reservoirs, and streams. Still unknown in Montana waters, it is capable of explosive growth, crowding out more desirable native plants, making waterways impassable and unusable, and creating serious dissolved oxygen losses in the water when it decomposes.

Like all other plants, rooted aquatic plants produce oxygen during photosynthesis. But they also consume oxygen through respiration during growth, and decomposition after death. This can lead to problems of oxygen deficiency when the plants are overabundant, particularly in shallow lakes (Freezout Lake near Great Falls is an example).

During decomposition, much of the organic material of these plants is released into the water as inorganic nutrients and recycled in the aquatic system. Thus, they act as nutrient pumps, cycling nutrients into the water. Conversely, they compete with algae for nutrients and light during much of the growing season and may suppress algal gowth below levels desirable for best fish growth. They are food for aquatic invertebrates, including zooplankton, mollusks, and insects, which, in turn, are important food for young waterfowl as well as fish. Decomposition is usually incomplete so the plants leave an organic residue which gradually accumulates and is a major cause of the filling-in process inherent in natural lake succession.

Rooted aquatic plants modify aquatic habitats by stabilizing bottom sediments and improving water clarity. They cool sediments by shading out sunlight, creating a layer of cooler water beneath the leaf canopy which provides a refuge for fish during the summer. They provide cover for game fish and forage fish—in some cases, too much cover, so that forage fish are less available to predaceous species and game fish are inaccessible to the angler. The leaf surfaces are habitat for tremendous numbers of aquatic insects vital to trout, and the vegetation is used as food and nesting material for waterfowl and furbearers.

In view of the beneficial aspects of many aquatic plants, why are they so often objectionable in waters whose primary use is recreation? Simply, because they are capable of physically obstructing a waterway, as well as limiting the accessibility to fisheries resources. continued on page 13

photo: Larry Dech

# Don't Risk the Water

## by Christine Deveny

YOU ARE hot and dry, and that beautiful, clear, cascading mountain stream promises sweet, refreshing relief. You approach the stream bank with mouth-watering anticipation and kneel down for that first glorious gulp—unaware that a tiny pest may be lurking in that pristine water, just waiting for a chance to make a new home inside the intestinal tract of a warm-blooded creature like you.

Although relatively unpublicized until recently, *Giardia lamblia* is actually the most common intestinal parasite in the United States. It may be the most unwelcome guest you ever have, and its visit could result in a serious diarrheal infection: giardiasis.

The organism may find its way into a human host through food or water contaminated by fecal pollution. While it is unable to grow and reproduce outside the host, it *can* survive without the host because of a thick, protective covering called a cyst. If it is passed from the host in fecal material in this cyst form, the protozoan may survive a long time, depending on water temperature. For example, in a mountain stream at 46.4°F (8°C), *Giardia* in its cyst form could remain alive for two to three months. At 69.8°F (21°C), that period is reduced to one month, and at 98.6°F (37°C), it could survive only about four days.

Once a cyst is ingested by an unsuspecting mammalian host, it begins a precarious journey through the host's digestive tract. In the stomach, acidic conditions cause the organism to shed its protective cyst wall, and to emerge in a free-living form (the trophozoite). The trophozoite is much more vulnerable to the harsh stomach environment and, in order to survive, the organism quickly moves into the small intestine. There it attaches to the intestinal wall. Within a few days, it divides, multiplies, and colonizes the intestine with thousands of progeny in the trophozoite form. Some of the offspring remain attached to the wall, continuing to colonize the intestine, while others are excreted from the host's body. During this exodus, some trophozoites are capable of enveloping themselves in a cyst, which once again allows survival outside the host. The less fortunate trophozoites which leave the host without forming cysts soon perish.

Besides being the source of new *Giardia* organisms able to infect new hosts, the trophozoites remaining in the intestinal tract are also responsible for causing the unpleasant symptoms of giardiasis, of which diarrhea, abdominal cramps, bloating, fatigue, and weight loss are the most com-

mon. Persistence of the symptoms varies from case to case. More "fortunate" victims might have them for only a week, but others might be debilitated for months. A visit to a physician is necessary for diagnosis and treatment.

Giardiasis can be diagnosed when *Giardia* cysts are identified in stool specimens by a common microscopic examination—but it isn't always as easy as it sounds. In some cases, symptoms of giardiasis will develop before a significant number of detectable cysts are excreted; it may take as many as three stool sample examinations or more before the cysts are found. As a result, *Giardia* organisms are sometimes overlooked as the cause of the symptoms.

Unlike many water-borne pathogens (disease-producing organisms), *Giardia* cysts cannot be detected by analyzing a standard water sample. The Environmental Protection Agency has only recently developed a method by which to detect the cysts which involves filtering them from a suspected water source. However, at least 100 gallons of water are needed for the process to be effective, and the method is tentative, time-consuming and somewhat costly.

No magic potion, inoculation, or medicine can prevent giardiasis. Only the symptoms can be treated, and quinacrine and metronidazole (Flagyl) are most commonly used. Unfortunately, adverse side effects are associated with these drugs. Both quinacrine and Flagyl sometimes cause dizziness, headache, nausea, and vomiting, and Flagyl is believed to cause cancer in laboratory animals.

Not all persons who harbor *Giardia* in their intestinal tracts become ill with giardiasis. However, these so-called "asymptomatic carriers" of the *Giardia* cysts can shed them for years and spread the parasite.

High concentrations of *Giardia* cysts found in water near beaver habitat led to the early belief that beavers were the main carriers of *Giardia*. However, researchers have also found *Giardia* cysts in cats, dogs, horses, cattle, rabbits, marmots, ground squirrels, mountain sheep, elk, and many other mammals. Despite this large range of hosts, some Colorado researchers have found the incidence of *Giardia* organisms to be lower in areas where human contact is minimal and higher in popular backcountry recreational areas. This indicates that humans are the primary sources and spreaders of *Giardia*. In turn, improper body waste disposal is the primary cause of contamination.

As a hiker, skier, backpacker, hunter, or camper, you can prevent contamination of water supplies by utilizing a little backcountry hygiene and courtesy in disposal of body wastes. Wastes should be kept at least 100 feet from any streams, springs, or drainage areas, and then covered with several inches of soil. The soil will aid in the rapid decomposition of the wastes and keep them away from insects and animals. When you consider that a single human stool specimen can contain over 300 million cysts, and that from 10 to 25 can cause infection, one incidence of careless backcountry hygiene can be disastrous.

To avoid becoming a victim of giardiasis, consider the following precautions:

1. When out on a short day hike or cross-country ski trek, carry drinking water obtained from a safe source.

2. When camping overnight, boil the water you will use for cooking, drinking, and brushing your teeth for at least 10 minutes to ensure the destruction of all cysts. (To remove the flat taste that boiling gives, aerate the water by pouring it back and forth between two clean containers.)

3. Iodine purification tablets are quite effective in destroying *Giardia*

## Giardiasis Outbreaks In Montana

Outbreaks of giardiasis associated with municipal water supplies have occurred in two Montana communities.

In July 1977, sewage contaminated the White Sulphur Springs water supply and numerous residents contracted giardiasis. Fortunately, removal of the contamination source and increased chlorination solved the problem.

In Red Lodge, the story was different. In 1980, over 300 cases of giardiasis were reported. The peak occurred in summer, and prompted involvement by local, state, and federal agencies. With such a high incidence in a small community, the water supply was immediately suspect.

Red Lodge receives its water from Rock Creek, a crisp mountain stream above town. But the creek is sometimes turbid, has impacts from livestock, residential development and beaver populations, and there have been problems with disinfection of the water supply. To combat this situation, the chlorine disinfection concentration was increased, and the water is now filtered through diatomaceous earth filters.

Even today, visitors to Red Lodge will find that a "boil order" is in effect. Although the incidence of giardiasis has declined since 1980, cases are still diagnosed here more frequently than in any other Montana community. Are these new cases attributable to the water supply, or are the cysts spread through person-to-person contact with carriers or food sources? Are some people developing resistance to the organism? The answers may never be found.

In Red Lodge, as in White Sulphur Springs, attempts to isolate *Giardia* cysts from the suspected water sources failed. Giardiasis diagnoses were based on finding the cysts in stool samples of those persons experiencing the typical debilitating symptoms. Giardiasis has been so common in Red Lodge that some physicians skip the time-consuming process of identifying cysts in stool samples and prescribe the drug treatment immediately.

In 1980, 434 cases of giardiasis were reported in Montana (including the Red Lodge cases). In the Rocky Mountain region, 2,020 cases were reported, and in the United States, 11,013 cases. However, only 44 states participated in reporting giardiasis cases. In 1981, 168 cases were reported in Montana, with no major outbreak in any community. When reading these figures, it is important to realize that epidemiologists have found that when no actual surveillance is conducted to ensure that all or most cases are reported, one can assume that reported figures may represent only 10% of the actual number of cases. Therefore, there could have been as many as 1,680 cases of giardiasis in 1981 in Montana—or 213 cases for every 100,000 Montanans.—*Christine Deveny*

cysts, but they can impart an objectionable taste to the water. (Chlorine purification tablets won't do the job.)

4. Some small filters have been developed which have been effective in removing the cysts under laboratory conditions. However, they may be unreliable after jostling around in a backpack, and their additional weight is another consideration.

5. As sources for drinking water, avoid slowly moving streams, swampy areas, shallow ponds, and drainage areas because *Giardia* cysts are more likely to be found in higher concentrations in these areas. The fewer the organisms present, the fewer you are likely to ingest.

The high incidence of giardiasis in mountain backpackers and campers led to the condition's nickname, "backpackers' diarrhea." But this description is no longer completely accurate because increasing numbers of giardiasis outbreaks are now attributed to municipal water supplies (see sidebar). In most, the water source is surface water in which mild chlorine disinfection is the only treatment provided. (Don't be surprised to learn that many of these municipal water supplies originate within popular outdoor recreational areas.) Strong concentrations of chlorine over a long period of time are necessary to destroy the hardy *Giardia* cysts, especially when the water is turbid and cold. Therefore, normal chlorine disinfection of municipal water, particularly in mountainous northern states like Montana, is ineffective against *Giardia* cysts.

cyst of *Giardia lamblia*

Filtration, preceded by chemical flocculation (processes which coalesce and settle out suspended particles in the water) and sedimentation, is considered best for removing *Giardia* cysts from municipal water supplies. The best available filters are those made from the hard silica remains of diatoms, a type of algae (DE), or a graded sand and gravel medium. However, unless the system is properly operated and the water pretreated, cysts can slip through the filters because of their variable size and flexibility. Giardiasis outbreaks associated with municipal water systems raised so much public health concern in Colorado that filtration of all surface water supplies is now required.

With the number of backcountry recreationists growing every year, and with many municipal water supplies originating in these same popular recreation areas, it only makes good sense to practice proper backcountry hygiene. Besides, the next time you are hot and dry, and that beautiful, clear, cascading stream promises sweet, refreshing relief, remember what else it might promise. Consider the risk. The choice is yours. ■

**SUGGESTED READING**

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Meyer, E.A. and Jarroll, E.L., "Reviews and Commentary: Giardiasis," *American Journal of Epidemiology,* Vol. 111, No. 1, pp. 1-12, 1980.

"Proceedings of the National Symposium on Water-Borne Transmission of Giardiasis," Sept. 18-20, 1978, Environmental Protection Agency; Cincinnati, Ohio, 1979.

# Book Reviews

**MONTANA FISHING,** by Dale Burk, maps by Roger Parchen, Stoneydale Press, 295 Kootenai Creek Road; Stevensville, MT 59870, 1982, 140 pages, $4.95, paper.

"Montana Fishing" with 140 pages of text, photographs, and maps, will provide the first-ever listing of the state's new stream fishery ratings and an overview of fishing throughout the state, according to author Dale Burk, Stevensville.

"Montana Fishing" is the first to detail fishing potential in the warm-water fisheries of northeastern and southeastern Montana as well as the cold-water trout fisheries in the western part of the state, Burk says. Chapters detail fishing potential in Montana on a regional basis.

"Where-to" and "how-to" information is provided for larger streams, lakes, and reservoirs. There is an extensive look at fishing in both Glacier and Yellowstone National parks, a chapter on Montana state fishing records, and a chapter titled "Fishing Partner," telling the story of Burk's relationship with the late Len "Buck" Collier of Kalispell, to whom the book is dedicated.

Two guest chapters are included, one on fishing the Madison, Yellowstone and Gallatin rivers by writer/wildlife biologist Hugh Zackheim and another by this writer on fishing in north central Montana.

The stream rating chapter is the most likely to become a Montana fisherman's choice for reference. The chapter details new stream rating listings—Class 1 (highest valued fishery resource), Class 2 (highest priority fishery resource), or Class 3 (high priority fishery resource)—for 5,436 miles of Montana streams. Burk compiled the listing after working through the ratings for 17,196 miles of streams rated by the Montana Department of Fish, Wildlife and Parks with the help of computers. The book lists ratings for 353 stream reaches in Montana included in the top three rating categories.

"Montana Fishing" is Burk's 10th book and the third in his series on Montana's outdoor recreation published by Stoneydale Press.

He recently revised and updated the "Montana Fishing Guide—West of the Continental Divide," published by Mountain Press Publishing Co. Burk is also author of "A Brush with the West," about western art, and he collaborated with photographer Russell Lamb to produce "Montana," a large-format book about the state.—*Wayne Arnst, Great Falls Tribune outdoors editor*

# The Catchall

## Counting "Prairie Goats"

I feel the Super Cub surge forward and rapidly gain speed as I smoothly open the throttle. A few stabs on the rudder pedals keep the ship heading down the runway. The wheels lighten and with a little back pressure on the stick, we're airborne and heading into the sunrise.

Shortly before dawn on many isolated runways throughout the West, numerous small aircraft follow suit. Through most of July, when winds are calm and skies are clear, these planes carry a pilot and a wildlife biologist into the early morning skies to count and classify pronghorn antelope.

This morning, we'll be flying about 25 miles northeast of Roundup, to survey subunit 9 of antelope Hunting District 530. Subunit 9 comprises about 210 square miles of grasslands, sagebrush basins, a scattering of winter wheat fields, and badlands. There are few occupied ranches or gravel roads on the boundaries of the subunit, and none within it.

As we fly to the starting point, the sun blazes into view. A few jackrabbits, a golden eagle, and a coyote scurry about as we interrupt the quiet prairie dawn.

The Department of Fish, Wildlife and Parks has seven administrative regions in Montana. Five have huntable populations of antelope. Biologists in each census a portion of the region's antelope range every July. In Region 5 (Billings), half of the hunting districts are flown annually so the complete region is covered every two years.

As we approach the beginning of subunit 9, I throttle back, add a notch of flaps, and settle to a cruise speed of about 60 miles per hour. We're roughly 75 feet above the ground and will remain so for most of the next several hours. We will follow section lines north and south, working our way westward mile by mile, until we've covered the entire subunit. We will find the section lines by looking for fences or trails where possible, or dead reckoning it using landmarks such as oil fields, stock reservoirs, or abandoned homesteads.

The first antelope of the morning show up as white dots on a hillside a half mile to the west. I hand over control of the plane to Orville Moore as I ready map, pen, and clipboard. He pours on the power, throwing in a steep bank that pushes me back into my seat. I hurriedly jot down a "1" in the observation number column, circle a "1" on the map in the proper location, and look up in time to see nothing but blue sky out my left window and sagebrush on my right as he makes another tight bank. He cuts the throttle and adds full flaps as we approach the herd.

The idea is to approach them so they will line out and head back into the area we've covered, so we can avoid duplicating counts. If, on the next pass to the west, I observe a similarly composed group of running antelope in the general vicinity of a previous count, I assume I've already counted them. I prefer to underestimate.

The "prairie goats" have obligingly lined out and are heading east as we close in behind, then pass slowly by. I first count total animals, then count fawns only. I then look for adult and yearling bucks. The yearlings have horns about the length of their ears, while those 2 years or older have horns a foot or more long.

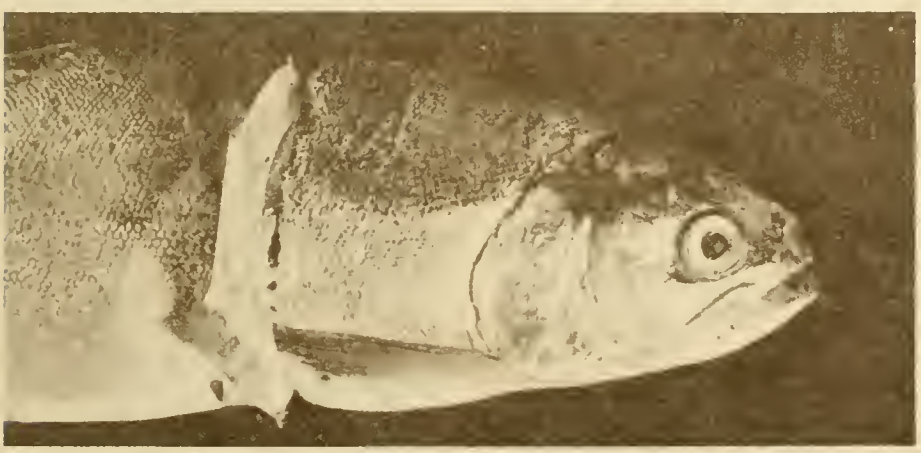
This herd has 16 total animals, including six fawns and a very respectable buck. As Orville heads back to our section line, I jot down the numbers in their columns. Most of the herds we see are yearling and adult does and fawns of the year, often with an adult buck in the group. The yearling bucks are mostly in separate herds. We also see many lone bucks, and single does with a fawn or two.

An hour or so of this kind of flying gives you a good case of "numb-butt," so we occasionally land on a relatively flat piece of real estate to take a break. Orville is the chief pilot, but I've been learning to fly the Cub for about a year, so I frequently take the controls for the less demanding maneuvers. When it comes to tight banks at slow speed, or landing on the edge of a coulee, Orville is definitely at the stick.

We've been flying for nearly four hours now. We've seen hundreds of antelope, although there were long stretches when we saw nothing but an occasional band of domestic sheep, a golden eagle now and then, or a coyote. At other times, the prairie seemed alive, with antelope in every direction.

While driving through a land so open and apparently flat, it seems that you could see every antelope within miles. Yet, frequently you see few or none. Hunters and ranchers often tell me they believe antelope numbers are way down, but our annual census tells a different story. Even though we cover every square mile of a hunting district during optimum viewing conditions, we probably miss at least a third of the antelope there. A herd bedded down, or behind a low hill, is next to impossible to see.

Antelope numbers in Region 5 are as high as they have been since complete coverage censusing was begun in 1961. Just a few years ago, two severe winters devastated many herds, but they have come back very well with two mild win-



**PUT LITTER IN ITS PLACE—Caught above Hauser Dam by Nick Krug of Helena, this fish used to be living evidence of why it's so important to put litter where it belongs—so it can't find its way into unfortunate places, such as around the belly of a trout (DFWP photo: Tom Warren).**

ters, high production and survival of fawns, and closely controlled permit hunting. Most does have two fawns once they reach 2 years old, and if the winters don't kill them and the coyotes and eagles don't take too many, antelope populations expand rapidly on good ranges.

We are approaching the airport and I'm at the controls again. As we settle down on the strip and taxi toward the hangar, I reflect on the morning's work. The sun is high now, and the wind is picking up. We've classified nearly 1,000 antelope. Four-fifths were does and fawns—about an equal number of each. We saw about 200 bucks; a third of these were mature bucks, some with horns at least 14 inches long.

All antelope hunting in Montana is strictly on a permit basis. Hunters apply for a permit in the hunting district of their choice in June. Although tentative quotas are listed for each hunting district at that time, final quotas are not set until after the annual July census. Most hunting district permits are for either-sex antelope, including fawns.

When I finish the annual antelope census, I'll have a pretty good idea of the number of does, fawns, mature bucks, and yearling bucks in a hunting district. Questionnaires and check station information tell us the harvest for past years, including the percentage of bucks, does, and fawns taken. We know from past questionnaires that a fairly consistent percentage of hunters will not show up to hunt and, of those who do, a relatively consistent percentage will be successful.

Access to hunt antelope on private land is a problem in some areas. Before setting permit numbers, it is necessary to know the numbers and distribution of antelope to which access is unavailable so they can be deducted from the census.

We have also found that some hunting districts are consistently more productive than others, and can sustain a heavier annual harvest without detriment.

I use all of this information to recommend a final number of permits to be issued for each hunting district in my area in order to harvest a certain number of antelope. We may want to decrease populations in some hunting districts because the animals are too numerous and are beginning to damage their range or create problems for farmers and ranchers. In other hunting districts, we may want to maintain a stable population, or allow it to increase somewhat.

Orville and I will fly again tomorrow and every morning, weather permitting, until we've covered two hunting districts—roughly 1,200 square miles. As long as we have the funds—provided by hunter license fees—to carry on this work and as long as productive antelope range remains, antelope will continue to provide countless hours of recreation and prime table meat for hunters.—*Tom Butts, fish and wildlife biologist, Roundup*

## Wildlife Society Awards

The Montana Chapter of The Wildlife Society presented Tom Mussehl, a department wildlife biologist and planner in Bozeman, with its Biologist of the Year award, and Bob Eng, professor of fish and wildlife management at Montana State University, with its Distinguished Service Award. The awards were presented during the group's annual meeting in Billings in February.

Although the Biologist of the Year award has been available for several years, 1982 was the first time it has been presented. Mussehl received the honor in recognition of his role in helping to counter the indiscriminate use of pesticides in Montana. He joined the Department of Fish, Wildlife and Parks in 1958 as a research biologist and became chief of the Game Research Section of the Wildlife Division in 1966. Mussehl was also a charter member of the Montana Chapter when it was established in the early 1960s.

Eng has been teaching fish and wildlife

## Remember Dan Bailey: Go Fishing Aug. 14

graphics: Vern Craig

Dan Bailey, noted Montana fly fisherman and pioneer in fish conservation, died May 23 in Livingston, Mont. To commemorate his many contributions to trout fishing and to the preservation of Montana's water resources, the Montana Fish and Game Commission passed a resolution decreeing Saturday, Aug. 14, as Dan Bailey Fishing Day throughout Montana.

The Commission's resolution stipulates:

> Whereas, the Montana Fish and Game Commission takes note with sorrow and regret of the death of Dan Bailey of Livingston, Mont.,
>
> And whereas, the contributions of Dan were of such magnitude that it is now assured that for generations to come, Montana anglers will have a riffle for their flies, a trout for their efforts, and flowing rivers for their souls,
>
> And whereas, the special relationship between Dan Bailey and the Yellowstone River ordains that his spirit will forever dwell hip-deep in its waters, and that these waters will run free as long as anglers share his love and respect for the river,
>
> Now therefore be it resolved, that consistent with Dan's instruction, the Montana Fish and Game Commission decrees that Saturday, Aug. 14, is Dan Bailey Fishing Day throughout Montana,
>
> And be it further resolved, that all Montanans on that day give pause and take proper note of the contributions of Dan Bailey now recorded and forever remembered in sparkling riffles, still pools, and wild trout.

Dan Bailey was a nationally known authority on fly-fishing whose trout flies were used by anglers around the world, but another important side of the man is less well-known. An early advocate for preserving the quality of Montana's trout waters, he was one of the founders of Trout Unlimited in the state, and served on numerous boards and committees concerned with fish conservation and water quality. He worked tirelessly to maintain and improve the quality of the Yellowstone as a trout-producing river; when the Yellowstone was threatened—whether with a dam, water pollution, or stream bank alteration—one thing was certain: Dan Bailey would be in the forefront of those speaking in behalf of the river.

Although he had the opportunity to enjoy trout fishing in many parts of the world, Dan Bailey always maintained that the Yellowstone country topped them all. It is appropriate that Montanans set aside Aug. 14 to pay tribute to this gentle, but determined, man, who gave so much to the future of fishing in Montana.

management at MSU since 1965. He is also director of fish and wildlife management and research in the Biology Department at MSU and on the staff of the Montana Agricultural Experiment Station. He previously worked for the department as a biologist, chief of wildlife research, and district supervisor in Great Falls.

The Wildlife Society is an international organization, primarily composed of professional wildlife biologists. The national membership exceeds 7,000, and the Montana Chapter has approximately 120 members.

## Rivers Film Wins Golden Eagle

The latest Department of Fish, Wildlife and Parks' documentary, "All for the Rivers," has won the prestigious Council of International Nontheatrical Events (CINE) Golden Eagle. This is the first time a department effort has received this accolade.

After screening by a regional jury comprised of film specialists, the film advanced to semifinals juries and ultimately to finals juries in Washington, D.C., CINE's headquarters. Over 800 films were entered in the regional competitions.

The film depicts the free-flowing rivers of Montana with all their energy, splendor and productivity. It was directed by Mike Gurnett, chief of the department's Film Production Unit; David Wayne of the television series, "House Calls," narrated the film, and original music was provided by the Montana band (formerly Mission Mountain Wood Band).

The film has also been selected by CINE to represent the United States in competition overseas.

It is available as a public service from the Department of Fish, Wildlife and Parks Film Center; Helena, MT 59620 (406/449-2426).

## Missoula Warden Named "Officer of the Year"

Ed Kelly, a warden for the Department of Fish, Wildlife and Parks in Missoula, was named Montana's Wildlife Officer of the Year by Shikar-Safari Club International. Kelly received his award from Department Director Jim Flynn at the March Fish and Game Commission meeting.

Safari Club International is a select group of sportsmen, limited to no more than 200 members. Recognition of outstanding conservation officers is one of many club programs to advance an understanding of wildlife worldwide.

Kelly joined the department in 1972. His law enforcement career has been spent in Missoula, except for two years in Ennis from 1973 to 1975. He is now responsible for one of two warden districts in the Missoula area.

In nominating Kelly, Warden Capt. Earle Davis noted: "Throughout Warden Kelly's career with the department, he has consistently demonstrated exceptional devotion to his job and a high degree of expertise in his field. He is active in many community affairs and devotes a generous portion of his time to programs concerned with water safety, hunter safety, and snowmobile safety at the elementary and high school levels."

**BIG HOLE MONSTER—This 19½-pound brown trout might be the largest trout ever caught by electrofishing in a Montana river. The 31-inch brown was shocked in the Big Hole River March 26, 1982, between Divide and Melrose, by Dick Oswald (holding the fish) and Tom Mosolf, both temporary fisheries field personnel. Fisheries biologists note this brown is especially amazing because it is a resident river fish. Trout of this size are rarely seen anywhere, but when they occur it is usually in a lake or on a spawning run out of a lake—*Steve McMullin, fisheries biologist, Dillon***

## Audubon Council Publishes Guide

The Montana Audubon Council has published a guide to the "Distribution of Montana Amphibians, Reptiles and Mammals." Written by Larry S. Thompson of Helena, the book was published by the Audubon group as a way of generating additional interest and support for nongame wildlife, as well as adding to the scientific understanding of distribution patterns in the state.

The guide is intended as a companion document to P.D. Skaar's "Montana Bird Distribution," published in 1975 and expanded in 1980.

Funds from the book's sale go to the Audubon Society. Copies cost $3 each and are available from: Montana Audubon Council, c/o 101 Pine Street; Helena, MT 59601, from individual Audubon chapters, or at major bookstores.

## Of Water, Weeds and Man *continued*

From what we know about the characteristics of macrophytes, we would expect them to occur in greatest numbers and diversity in shallow, relatively clear lakes and ponds with stable water levels, overlying rich, fine-grained soils. This also usually describes a naturally eutrophic situation.

Cultural eutrophication in the form of continual nutrient loading from urban or agricultural sources can result in the reduction of rooted aquatic plants due to the production of heavy algal blooms which shade them out. This is a common management practice in the Southeast and Midwest, where many small lakes and ponds are fertilized to promote algal and fish production. The same thing happens in cases of severe cultural eutrophication (see "On the Care and Feeding of Lakes," *Montana Outdoors*, July/August 1975).

Rapid changes occur in plant communities, often involving introduction of new species. Or, native species might become capable of explosive growth at a critical point in a lake's development. The latter appears to be the case at Georgetown Lake near Anaconda, which fulfills all the requirements for abundant macrophyte growth: an average depth of 14 feet, clear water rich in dissolved minerals, stable water levels, and rich underlying soil. Given these conditions, it is not surprising that Georgetown has a history of problems with overabundance of water weeds.

Georgetown has been the object of intense study for the past seven or eight years, and marked changes in the density and distribution of certain species of aquatic plants have been well-documented. Big-leaf pondweed, a perennial species which reproduces by seed and runners, grows in water from 10 to 20 feet deep, its shoots reaching the surface some time in early July. Aerial flowering spikes may be seen in late July and early August, when the plants reach their maximum size. In September, the stems lose their buoyancy and sink part way to the bot-

tom. Growth continues at a reduced rate, however, and new stems start growing in the fall. These grow slowly under the ice and mature the next summer. The old stems decompose during the winter and early spring, releasing their nutrients to the water. The plants grow in clumps, providing excellent cover for trout and other small fish, as well as many aquatic insects.

Comparisons between the same areas photographed in 1975 and 1981 show an increase in surface coverage of big-leaf pondweed of approximately 100%. In many locations, the plants now occupy up to 70% of the lake's surface area. Although some habitat of this type is desirable, too much of a good thing renders large areas of the reservoir—one of the most popular in the state—inaccessible to outboard boats during much of the recreation season.

Other weeds with nuisance densities in Georgetown are elodea, Richardson's pondweed (*Potamogeton richardsonii),* and water-milfoil. All are most abundant in water from four to eight feet deep and capable of reaching the surface in solid canopies which obstruct boating and fishing.

The current Environmental Protection Agency-sponsored Clean Lakes Study has revealed some interesting relationships between common indices of water quality relative to eutrophication and aquatic weeds. Comparing the summers of 1975 and '81, algal density on Georgetown decreased 50%; dissolved phosphorous decreased by about 50%, and water clarity increased 20% to 40%. These figures indicate a reversal in the eutrophication process. At the same time, total plant growth remained the same or increased slightly.

Experiments with "weed corrals," which isolated small areas of plant growth, indicated that rooted aquatic plants tied up nutrients sufficient to support algal growth more than 10 times current summer levels. While densities that high are not needed, a better balance between algal gowth and weed growth would result in optimum fish growth and better availability of fish to the fisherman.

Balance seems to be the critical objective for many environmental management endeavors. In the case of water weeds, the best situation in terms of fish production and all-around recreational use is: None is not enough, and too many can cause serious use limitations.

The most obvious way to control nonnative, exotic species is prevention—don't allow their introduction. But ecological history is full of disasters caused by accidental or thoughtless release of exotic species: chestnut blight, Japanese beetle, English sparrow, European starling, Oriental tent caterpillar, carp, and, more recently, Mediterranean fruit fly and Eurasian water-milfoil.

Once a species is established in the wild, the problems of excluding or containing an exotic may be almost insurmountable. Most species have so many avenues of transmission that the best containment and eradication programs fail, often at great economic and environmental cost. Montana waters are a prime candidate for invasion by Eurasian water-milfoil, if indeed it is not already present. Many species (and probably this one) are transmitted in the gut and feet of waterfowl, so the effectiveness of a quarantine program is questionable.

Ways of maintaining a balanced aquatic plant community have been explored recently, many involving direct manipulation of aquatic environments. Mechanical harvesting, aquatic herbicides, sediment removal by dredging, manipulation of water levels, biological control (such as grass carp), shading by use of screens, and plastic sheeting and dying the water to reduce light penetration have been tried with varying success. All have been useful under certain circumstances and all have their drawbacks.

Mechanical harvesting is being used successfully in many areas. Advantages include: Use is not restricted during the control program; selective treatment of problem areas is possible; no harmful substances are used; there are no adverse impacts on water quality, and some nutrient removal is possible, if desired. Disadvantages include: high initial costs, considerable labor and operating costs, the need for continual operation over several years, and the operating limitations of harvesting equipment. Some of the expense may be recovered if the plant material can be marketed.

Aquatic herbicides have been used for many years. Although annual control is obtainable, regrowth usually occurs. Advantages are relative ease of application and lower initial costs, although herbicides are not inexpensive. Disadvantages are the possibility of severe algal blooms caused by nutrients released by dying plants, incomplete kill of macrophytes, degradation of water quality, limitations of use after application, and need for retreatment.

Dredging—with or without substrate modification such as addition of gravel or sand—is very expensive and can cause temporary impairment of water quality, such as turbidity, oxygen deficits, or algal blooms. It provides long-term benefits in reduced weed growth and may also enhance the oxygen balance of lakes by reducing biological oxygen demands and improving the volume-to-depth ratio.

Manipulating water levels has been tried with varying results. Problems associated with this method involve the creation of severe oxygen deficits during the drawdown, which is usually done during the winter, and algal blooms after refilling. Drawdowns may also interfere with other water needs, such as those of industry or agriculture.

Biological controls are limited thus far to grass carp (a primarily herbivorous fish related to the European carp), parasitic insects, and specific viruses or bacteria. Although successful control programs using grass carp have been established, the problems of introducing a new species into a new environment are a serious limitation. Grass carp are not strictly herbivorous, and may feed on both insects and small fish.

Other methods of aquatic weed control work most effectively when applied to small problem areas, such as marinas, swimming beaches, or small ponds.

Management of aquatic environments is not a cut-and-dried proposition and usually involves a considerable economic investment over an extended period of time. Initiation of any major program almost always requires funds from other than local sources. Federal assistance for such activities has been severely curtailed, although some states are still supporting programs involving macrophyte management because of the importance of maintaining balanced aquatic systems. ■

## Wildlife Shorts

Why are wild bird eggs different colors? With the birds' development of the nesting habitat as a protective device, the coloring of the eggs also became protectively adapted. Birds that nest in holes and protective crannies have whitish eggs—woodpeckers and kingfishers are examples. Birds such as the killdeer that nest in the open have streaked or mottled eggs.

* * * * *

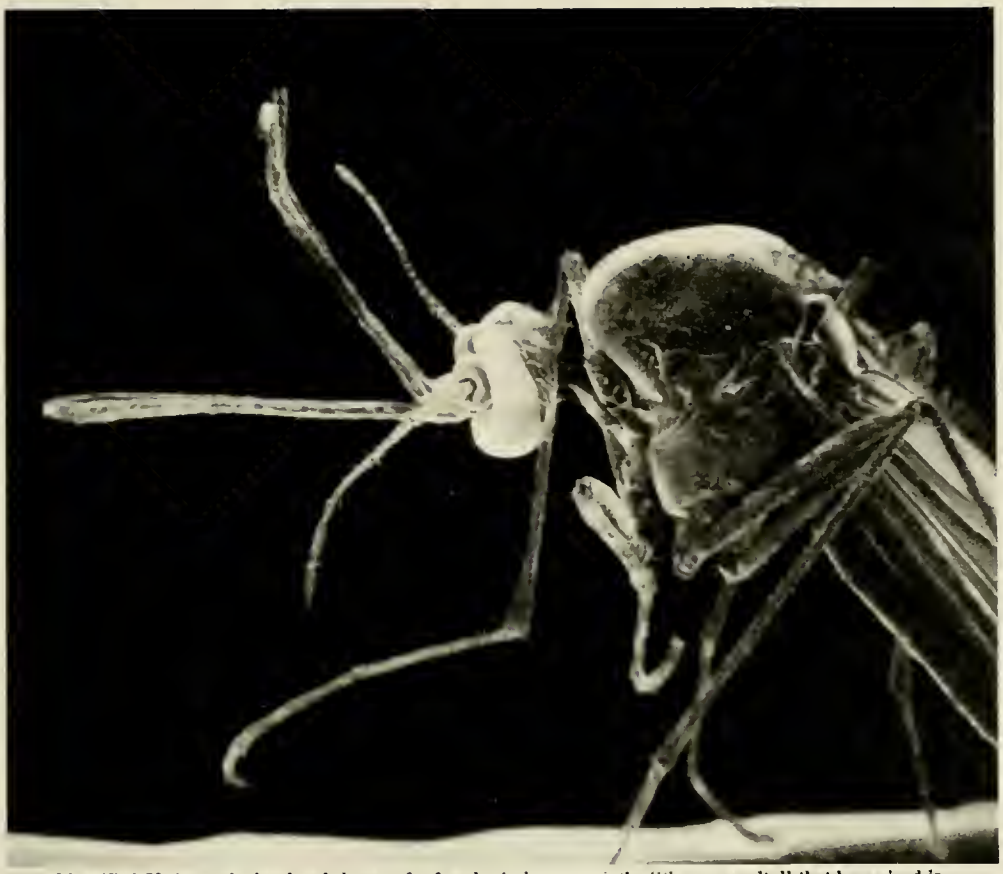
The development of a white winter pelage (or coat) is genetically fixed. This is an adaptation which best fits the animal into its immediate environment.

* * * * *

The only bird that can fly backwards is the hummingbird.

* * * * *

Can a lion outrun a man? Effortlessly. A human's top running speed is less than 25 miles per hour, while a charging lion could reach a speed of 50 miles per hour.—*Vince Yannone, youth educator, Conservation Education Division*



Magnified 50 times, the head and thorax of a female *Aedes aegypti,* the "tiger mosquito" that has gained infamy by spreading yellow fever throughout much of Africa and the New World (photo courtesy Joan Hudson, College of Sciences, Electron Microscope Facility, Clemson University).

# The "Bloody Nuisance" That Bites

SHE IS SMALL, delicate—even fragile—and *very* fecund. Under optimal conditions, her offspring could number 20 million individuals in only five generations. Her prodigious reproduction requires protein, and this she derives from blood—the blood, for example, of a cow, horse, pig, rabbit, bird, or, all too often, an already irritated fisherman. She is a mosquito...and a bloody nuisance.

It may be possible, although it is unlikely, that somewhere on this planet lives an adult human who has not had an encounter with one of the 2,700 species of mosquitoes so far identified. These "little flies" (indeed, the name mosquito is derived from the Spanish word meaning "little fly"), which are closely related to houseflies, stable flies, tsetse flies, midges, and sand flies, are found globally except in the polar regions, over the oceans, in the worse of deserts, and at extremely high elevations.

Many species have nearly worldwide distribution. For example, *Aedes aegypti,* known commonly as the tiger mosquito, has gained infamy by spreading yellow fever throughout much of Africa and the New World, while the aggressive *Aedes vexans,* commonly encountered in Montana's meadows and prairies, causes discomfort throughout the temperate areas of both the Northern and Southern hemispheres.

The life history of the mosquito is an object lesson in the diverse means by which species accomplish the seemingly simple process of reproducing their own kind. A mosquito's life is comprised of seven stages: egg, four larval stages, pupa, and adult.

**by G. Wesley Burnett and Lisa Mathis Butler**

All except the adult stage are aquatic.

Eggs are laid singly or in "rafts" on water, or on dry ground subject to flooding. Incubation time varies with species and environmental conditions, particularly temperature and moisture. Under ideal conditions, a mosquito embryo can complete its development in about two days. *Aedes vexans* eggs, however, can remain dormant in cold storage for up to 20 months, and may in fact require subzero temperatures before development can begin.

After hatching, juvenile mosquitoes go through four larval stages, during which they are popularly known as "wrigglers." The wriggler, suspended by a breathing tube from the surface of the water, feeds on tiny particles of plant and animal matter. Species have evolved to exploit nearly every form of "fresh water" imaginable, from gully traps and pit latrines to quiet margins of clear-running streams. Indeed, specialization has proceeded to the point where certain species are adapted only to forest pools, tree holes, pitcher plants, or even empty snail shells. Larval stages vary from a few days to several months, and may be considerably longer than the adult stage. Although some eggs can withstand alternate wetting and drying, larvae die when their habitat dries—a fact of considerable significance in man's relentless battle with the mosquito.

The pupa stage is a nonfeeding transitional phase between larva and adult which normally lasts no more than a few days. Popularly known as a "tumbler," the pupa is anything but dull or torpid. During this brief nonfeeding period, the mosquito's body undergoes one of the most dramatic metamorphoses in nature. When it is completed, a rather soft and unpromising adult stands momentarily on the abandoned shell of its pupa, then takes its first tentative flight to the nearest safe location, where its external skeleton hardens and its delicate wings dry.

Because adult mosquitoes feed on plant nectar (the males never take blood), they may be important pollinators. In fact, if they needed nothing more than nectar, mosquitoes probably would have remained an obscure and poorly understood group of slightly bothersome flies. Their importance to man results from the fact that the female of almost all species must supplement her diet with protein derived from animal blood. The female may mate only once, shortly after emerging as an adult, or numerous times. In any event, the male's sperm is stored in her body to be released to fertilize her eggs as they develop. The protein, and consequently the blood, is needed for the development of the eggs. As long as blood is available to her, she may repeatedly produce eggs from a single mating.

The biting process of the mosquito is a complex affair; it was not fully observed by scientists until 1939, and it is not fully understood by them today. In a single blood meal, the female normally takes in 40 to 50 million red blood cells, which collectively weigh perhaps two and one-half times her own empty weight. She is persistent in obtaining her meal, even though the odds are perhaps 10 to one against her living to complete it. Yet, these odds are quite sufficient to guarantee reproduction of the species when hundreds of fertilized eggs are the result of one successful feeding. That is why an otherwise shy and unobtrusive mosquito will sit patiently on the fisherman's arm as he slaps the daylights out of it—and why, while the fisherman is thus occupied, the mosquito on his left earlobe was able to dine and escape unscathed!

While sucking blood, the mosquito releases little bursts of saliva into her victim. Why this is done is not clear; perhaps it helps to increase the blood flow to the mosquito. But what it does to people is all too clear—it is the cause of the characteristic itch and red welt commonly associated with a mosquito bite. Although individuals differ, most people can withstand the first few bites from a new species of mosquito without any reaction. After these first bites, however, there is a reaction to the

## New Hope for Mosquito Control

Residents around Saco, Mont. (also known as "The Mosquito Capital of the World"), experimented with a biological method for controlling these pests during summer 1981.

A bacterium known as *Bacillus thuringiensis* was aerially sprayed over test hayfields. Sample counts of mosquito larvae made before and after the application revealed an effective kill of almost 100% within 24 hours. Results were so encouraging that a special mill levy was sought to help fund the program for this year.

One outstanding advantage with the type or strain of *Bacillus* used in this experiment is that it attacks only the larvae of mosquitoes and gnats and does not affect other insects. Also, it is nontoxic to all mammals and has no apparent side effects in water, such as causing peculiar tastes or smells. However, this bacterium is effectual for only 10 days and must be reapplied after each flooding of the fields. Unfortunately, it kills only the early life stages (first or second larval instars), and will not kill the later larval stages or adult mosquitoes or gnats.

Another advantage of *Bacillus thuringiensis* is that since it was first discovered in Japan in 1901, no insect has built up resistance to it. Insects may never develop a resistance, since they lack an immune system against this naturally occurring pathogen. Also, *Bacillus* is competitive in cost with many of the new chemicals now used to control insects, because of growing insect resistance to the older pesticides. And, since it's harmless to the predators of insect pests, the predator population can continue to increase, thereby providing a further measure of control.

Several strains of *Bacillus thuringiensis* have been developed which are effective against other pests such as tobacco budworms, cotton bollworms, wax moths, cutworms, and other members of the Lepidopteran order. Perhaps in the near future we will finally see biological agents replace the widespread use of chemicals for control of insect pests.—*James E. Liebelt, Region 6 (Glasgow) information officer*

saliva which at first increases in severity and then subsides. Hence, most persons living in areas where they are constantly exposed to mosquitoes of the same species appear to have little or no reaction to the bites.

That may be of some satisfaction to those living in the tropics, but to those of us living in parts of the world with marked seasons, it is no satisfaction at all. Each week of the mosquito season brings forth new species of mosquitoes and for each of these we must go through the torment of establishing immunity. The immunity, however, is short-lived, because what is gained in the summer is lost in the winter. The process of immunity must be re-established with the onset of each new mosquito season.

The immunity process may help explain why fishing trips to new areas often generate more stories of horrid mosquitoes than of immense fish. The Montanan who chases bass in the swamps of Louisiana is meeting new species of mosquitoes to which he is not immune. He is likely to be as impressed with their ferocity as the Louisianan who stalks the wily trout along one of Montana's delightful streams infested with 10 unfamiliar species of mosquitoes.

The encounter with new species is made all the worse as the sportsman proceeds north. As the mosquito season shortens, hatching and maturation must be collapsed into periods of shorter and shorter duration. Finally, the point is reached where billions of individuals from a score of species simultaneously mature and begin seeking blood. Under these conditions, concern with immunity is beside the point—all animals seek only to evade the mosquito and survive the season.

If the only damage from the mosquito's bite was an itch and a red welt, scientific interest in this little fly would probably be limited. But mosquito-borne diseases have been a relatively constant plague on man's existence down through the centuries. Even so, it was not until the middle of the 19th century that a credible hypothesis relating certain diseases of man to the mosquito began to evolve. The list of diseases blamed in whole or in part on mosquito saliva now extends to four forms of malaria, dengue, two forms of yellow fever, several forms of filariasis (an infestation of tiny, threadlike parasites which take their most horrible and obvious form in elephantiasis, the gross swelling of limbs resulting from blockage of the lymph system), and encephalitis (a series of diseases known as "sleeping sickness" which affect the central nervous system and lead to inflammation of the brain tissue).

Some of these diseases have had a profound effect on human history. The spread of malaria in the New World may have contributed as much to the rapid fall of Indian empires as Spanish steel, horses, and greed. Yellow fever epidemics, usually in the busy ports, occurred in the United States at least 95 times between 1693 and 1901. Cities like New York, Philadelphia, and Charleston experienced severe epidemics. In New Orleans, epidemics traceable to Cuba took 11,000 lives in 1853 and another 6,000 in 1878. Even today, mosquito-borne diseases in some parts of the world reduce human endeavor to a creeping struggle for survival and condemn millions of people to lives of poverty and chronic illness.

Montana, fortunately, has been relatively free of mosquito-borne diseases. While *Anopheles freeborni,* the carrier of malaria in the western states, has been found in Montana on both sides of the Continental Divide and from Blaine County in the north to Powder River County in the southeast, the population is not sufficient to constitute a serious health problem. Malaria is and has been practically unknown in the state.

The most significant mosquito-borne disease in Montana is probably encephalitis, of which western equine encephalitis is the most important variety; 33 cases in horses and 12 in man were reported in Montana in 1965. St. Louis encephalitis, which infects birds, cattle, horses, and man, is also found in Montana. The culprit, *Culex tarsalis,* produces several generations of aggressive dusk- and dawn-feeding mosquitoes in a breeding season. Adults rest by day in grasses and shrubs, but they are also commonly encountered on the shady sides of buildings and porches. Eggs and larvae are frequently associated with irrigation water in canals, ditches, borrow pits, and impoundments, but because both eggs and larvae tolerate water with a high organic content, cesspools, dairy barns, and corrals also provide favorable habitat. The aquatic portion of the life cycle can be completed entirely in a hoof print. Fortunately for man, while the virus causing encephalitis is quite common in nature, it appears to be passed back and forth primarily between mosquitoes and birds.

As the realization dawned that mosquitoes could debilitate and kill, efforts to control or eliminate them mounted. Most early efforts concentrated on destroying mosquito habitat by draining swamps or oiling the surface of standing water. Then, with the advent of DDT in the 1940s, emphasis shifted to massive applications of this potent chemical to reduce mosquito populations. Unfortunately, both swamp drainage and DDT resulted in declining populations of numerous desirable wildlife species. The use of DDT was banned in this country in 1972, but wetland drainage continues to be a serious threat to wildlife.

Today, logic, prudence, and a greater appreciation of environmental processes suggest that man will never be free of mosquitoes. Entirely removing the mosquito from man's or his livestock's environment is apparently a hopeless task. But "natural" means can be used to reduce mosquito production (see sidebar). Careful agricultural practices, particularly those involving the use of irrigation and fertilizers, and maintenance of aquatic environments with large numbers of mosquito larvae predators—nematodes, bacteria, viruses, protozoans, and, thankfully, fish—can reduce mosquito populations.

For the sportsman, however, the classic confrontation with the female mosquito will continue—in the tent, in the cabin, and on the stream bank. Despite mosquito dope, screens, and netting, ultimate victory will continue to be the mosquito's. For every 20 that die on the fisherman's forearm, there will always be that one successful assault on the earlobe or cheek, followed by a quick escape to the nearest still pool, where eggs will be laid to produce another crop of that "bloody nuisance." ■

# A Park For All Reasons

Kalispell's Woodland Park is one of Montana's oldest and most exceptional city parks. It began with a 26-acre donation in 1903 and has grown to nearly 40 acres.

Woodland's seven acres of freshwater lagoon provide a home for up to 1,000 ducks, geese, and swans, and an aviary houses 15 other bird species.

Well-landscaped and maintained, the park provides the opportunity for a variety of outdoor activities. Swimming lessons, weddings, family reunions, baseball games, cross-country races, ice skating, picnics, and puppet shows are just a few of the activities that Kalispell area residents enjoy in Woodland Park every year

Although active recreation is a big part of Woodland Park's attraction, a quiet spot offering solitude is not difficult to find. ■

DFWP photo: Mike Aderhold

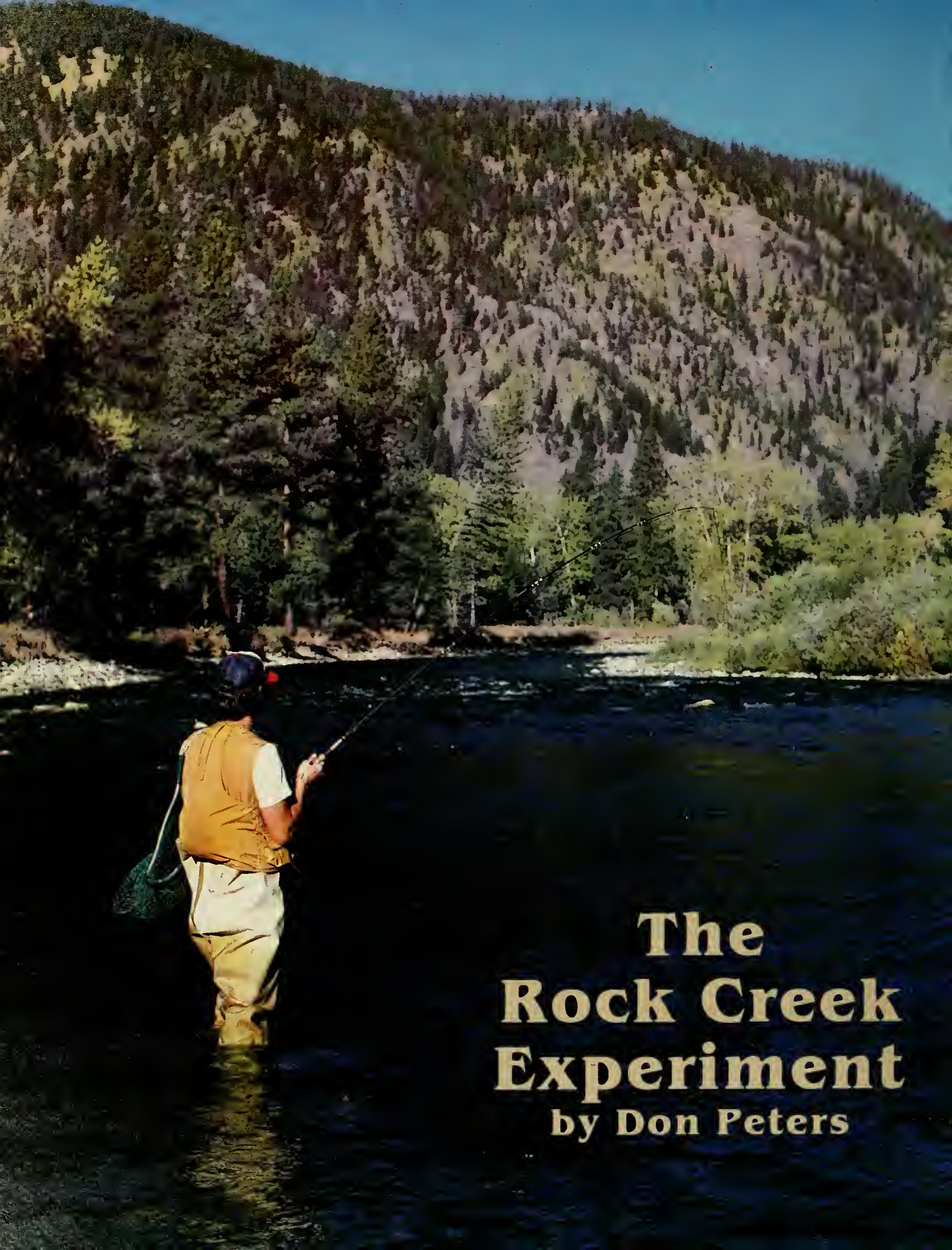
photo: Ad Clark

DFWP photo: Ron Aasheim

photo: Ad Clark

DFWP photo: Ron Aasheim

photo: Ad Clark



# The Rock Creek Experiment

by Don Peters

• *I would like to dedicate this article to Daryl Back, a devoted fisherman of Rock Creek I had the pleasure of knowing and who spent his final days of life in 1978 fishing Rock Creek. He had fished the creek since 1965 and had seen the fishing quality slip away in his 10-plus years of wading its waters. He had, in his 80-years-old gentlemanly way, spoken of ways he thought the creek could be revitalized. Mr. Back never had the opportunity to experience the improvement in the Rock Creek fishery, but I am sure he would take a great deal of satisfaction in fishing Rock Creek today.*—Don Peters

THE YEAR 1981 was one of sweeping conservative changes for national politics, aimed at retrieving a depressed economy. Likewise, fishery management in western Montana was going through conservative changes in attempting to retrieve some depressed populations of larger trout.

A change in management direction came about when fisheries biologists realized that many better trout streams could probably produce more larger trout if given the opportunity. To give the trout populations that chance, fisheries personnel recommended major reductions in creel limits, size limits, or seasons. Biologically, the trout populations appeared to be holding their own (even though the size of fish caught was decreasing); therefore, the Department of Fish, Wildlife and Parks sought the public's opinions about fish management goals. As an older friend of mine once stated, "There are at least 10 correct ways of doing any job"—and this job was no different.

So, the department conducted public meetings and discussions and published news releases to explain what we knew about trout streams and to list some management alternatives. Through the involvement of interested fishermen in western Montana, we gained insight into what they thought of the various management goals.

What came through loud and clear was a wish for streams with conditions "like the good old days." But another message came from staunch bait fishermen who also wanted improved opportunities for larger trout. The main problem with that position centers on the high mortality of trout caught with bait and released. The catching and releasing of trout "alive" is the basis of the special management regulations, and it is the trout manager's answer to the recyclable can—recycling trout. However, to try and accommodate the concerns of bait fishermen, the "five trout, only one over 14 inches" regulation emerged. The most important section of this regulation is the "one over 14 inches" part, which allows an angler a fair number of the more abundant, smaller-sized fish, but limits to one the less abundant, larger-sized fish. With the number of fishermen today, there are just not enough big fish to go around in most of the streams capable of producing them.

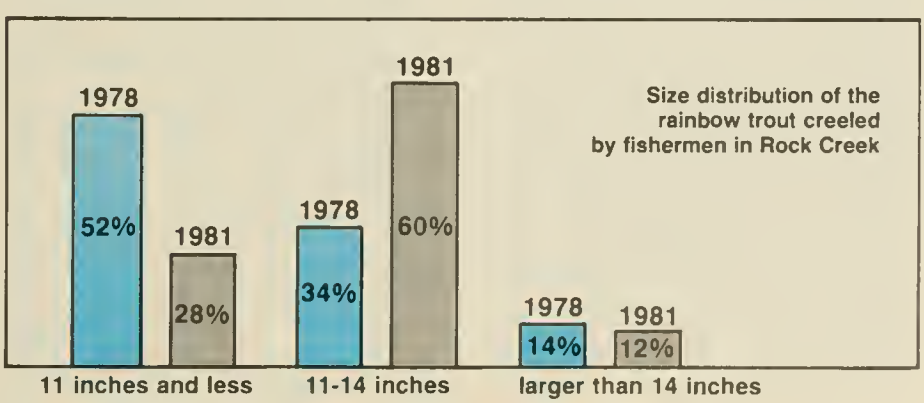
The public involvement sessions and proposals and the Fish and Game Commission meetings eventually resulted in the 1982 fishing regulations. The major changes can be separated into regionwide changes and special wild trout management areas. Regionwide changes include a reduction in daily bag limits for stream fishermen to five trout, only one over 14 inches. The only exceptions are the special management areas and the Clark Fork River below Milltown Dam.

On the Clark Fork below Milltown Dam, the limit is five trout, and only one can exceed 16 inches. The special management areas include: the *Clark Fork River* from the Anaconda Co. settling ponds to Perkins Lane Bridge (four miles) and the *Bitterroot River* from Stevensville Bridge to the Florence Bridge (eight miles), and a section from the Darby Bridge to the Como Bridge (six miles). These special management areas have either a five-fish limit on trout less than 14 inches, or a limit of four trout less than 14 inches and one over 18 inches. Artificial lures only are allowed in the special management areas.

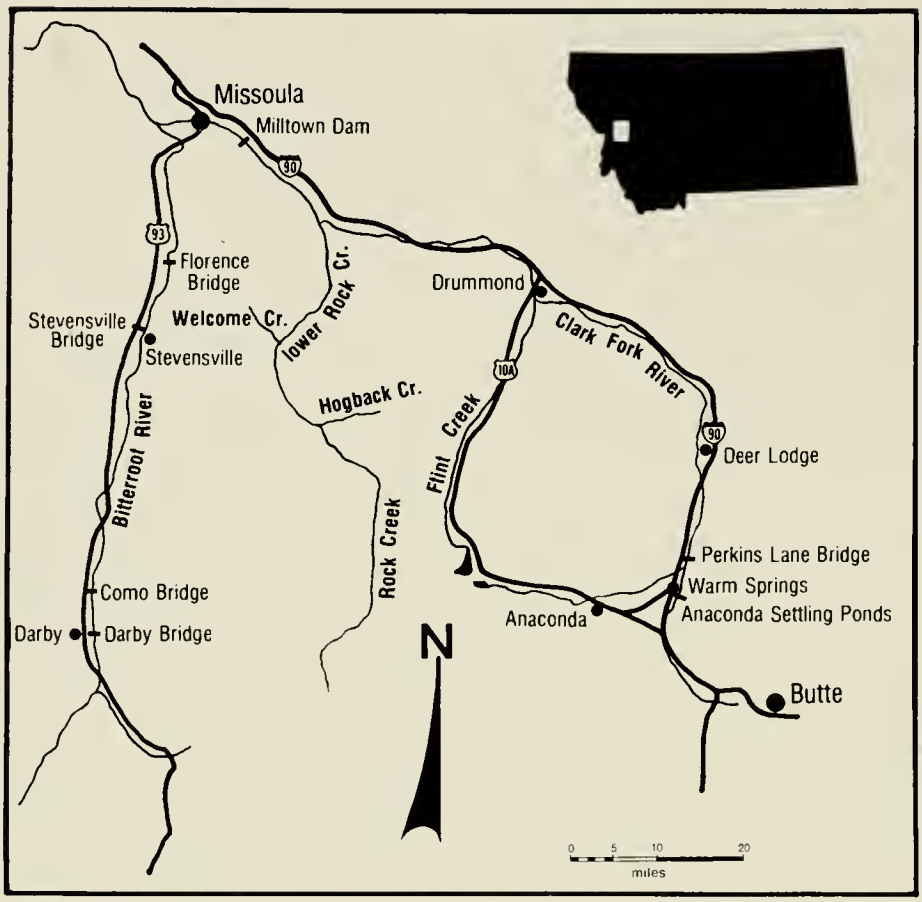
An experiment in fisheries management was launched in 1979 on Rock Creek—also a special management area—that may provide some insight into possible success of the 1982 regulation changes elsewhere. The goal on Rock Creek was *"to improve the opportunity of fishermen to catch trout larger than 14 inches long"* throughout the season—or "like the good old days." Good habitat, the basic ingredient to producing larger trout, was still available and had not changed significantly. But surveys and studies over 20 years had led fisheries biologists to conclude that heavy fishing pressure and resulting overharvest of larger trout had significantly altered the character (or quality) of the trout fishing available on Rock Creek. This was not a welcome change for most fishermen, so the department took a new direction. Special creel limits were imposed to reduce the number of trout taken by fishermen. Special creel limits established on specific sections of Rock Creek included: (1) three trout, only one exceeding 14 inches, and (2) catch-and-release fishing on a 12-mile section. Only artificial lures were allowed, a demonstrated means of improving the survival of released fish. Would the new regulations result in greater numbers of large trout?

No one person could answer that question in 1979. Nobody had ever tried such an approach in western Montana trout waters before. The new goals were not without skeptics —professionals, as well as those from the private sector.

For those who have not experienced the experiment on Rock Creek —it worked! The *degree* of success amazed us the most. Two major improvements have taken place in trout




Rock Creek (photo: George Wuerthner)




populations in Rock Creek: (1) a 200% to 800% increase in the number and size of easily caught or vulnerable trout, and (2) a 150% to 400% increase in the number of larger trout available to fishermen.

Electrofishing surveys in two areas revealed improvement in the numbers and size of easily caught species, especially cutthroat and rainbow trout. Lower Rock Creek offered easy fisherman access throughout the years and appeared to have been suffering more pressure than its populations of larger rainbow trout could withstand. In 1978, the estimated number of rainbow trout larger than 10 inches had dipped to a fall low of 39 rainbows for a 1.5-mile section; in 1981, the same section contained 316 rainbows larger than 10 inches. Similarly, 34 miles upstream near Hogback Creek, "native" or westslope cutthroat had been maintaining a low profile in 1978, hovering around 20 cutthroat larger than eight inches for a 1.1-mile section. The same section contained an astounding 139 cutthroat in 1981—and they were larger, too.

The number of larger trout has significantly increased in all three of our sampling sections. For example, since 1978, the number of rainbow trout larger than 11 inches in the Welcome Creek area has increased fivefold. Creel census surveys conducted in 1978 and again in 1981 have also shown increases in the number of larger trout that fishermen are catching; the percentage of rainbows between 11 and 14 inches caught by fishermen is up 26%. This occurred in spite of an increase in fishing pressure of 17%.

In the 1981 fall census, fisheries biologists found the highest numbers of larger trout seen in Rock Creek in recent years, once again in spite of mounting fishing pressure. Maintenance of last year's high populations should help guarantee success of the 1982 season.

Fishermen sacrificed something for these improvements in fish size: In 1981, 58% fewer fish were taken home than in 1978. Fishermen also caught and released an estimated 26,000 trout—*five times* more than were kept. In the future, it may be possible to increase the harvest beyond the 1978 level and still meet the goal "of improving the opportunity to catch larger trout." The key will be in selecting the size groups and trout species most able to withstand additional harvest.

So far, the Rock Creek experiment has met with significant success but some questions remain unanswered, such as: Will overpopulation occur when growth rates slow and fish begin to stunt? There is no sign of this yet, but department fisheries biologists will continue monitoring.

What about those rainbows larger than 14 inches? From creel censuses and fish population estimates, the low number of rainbow trout in that bracket is a result of the harvest of a greater percentage than could be allowed with our current goal (especially if the goal was to have larger rainbow populations producing near the biological potential of the stream), and overharvest of those fish approaching 14 inches, but still in the 13- to 13.9-inch group. This question is significant because the "overharvest" is taking place with a one-fish limit (three-trout limit, but only one exceeding 14 inches). The obvious conclusion: For Rock Creek to produce more trout larger than 14 inches would require no harvest of trout larger than 14 inches.

New special management areas on the Clark Fork and Bitterroot rivers reflect the Rock Creek findings. Larger trout are better protected with the 14- to 18-inch size catch and release, but allowing one larger than 18 inches and four less than 14 inches to be kept. Similar regulations have been implemented on sections of the Big Hole and Gallatin rivers where department research also indicated fishermen were having significant impact on larger trout.

The key to success of the Rock Creek experiment is Rock Creek's high quality trout habitat. Superb water quality and adequate instream flow during the entire year, enhanced by the natural character of the stream banks, provide some of the best of what we call "high quality trout habitat."

You might say the fish habitat —and now the fish—in Rock Creek are both "like the good old days." ■

# Readers Respond

## Helping Out the Grizzly Bear

Here is one fellow who was certainly interested in the May/June 1982 issue of *Montana Outdoors*—so much so that when my secretary read the article to me on grizzly bears, I thought that I ought to do something to help them out as I am an old-timer in the Rocky Mountains. I am enclosing a check for $100 to help out a little bit on this project.

I don't know if I ever saw a grizzly, but I think I did as a boy on a camping trip. We saw a bear cross a snowbank above timberline on the Continental Divide. Usually, black bears never go up that high.

I was raised in northwestern Colorado and an old trapper who had a small ranch near the Wyoming line used to come down and visit us at our home. Sometimes he would say: "I saw a silver tip recently that must have drifted down out of Wyoming." I remember an old-timer near Central City who had lost darned near half of his face, besides an eye, and who said he had been in a fight with a grizzly bear. I don't know who came out on top, but I know this fellow didn't look very good for his encounter.

I doubt if there are any grizzly bears left in Colorado, so I hope we can keep a few in Montana and I expect there are a few in Idaho.

In closing, I want to congratulate you people on this wonderful magazine. I sent subscriptions to several executives in the automotive industry with whom I deal and I am enclosing a copy of the letter I received from the vice chairman of General Motors Corporation thanking me for his.

I expect that when people see this issue with the mountain lion and grizzly bear, they will reconsider taking a trip to Montana this summer. But I can tell you, if it wasn't for my age of 82, I would be up there again.—*Marcellus Merrill, Merrill Engineering Laboratories; Englewood, Colo.*

• *Thank you very much for your gift of $100. We have earmarked this gift for use in the grizzly research program. It is with the help of concerned people like yourself that further study on these special programs can be accomplished. We also appreciate your good words for* Montana Outdoors.—Ed.

### Coming in September

**Can't tell a ruffed from a Franklin's? The "Identification Guide to Montana's Upland Game Birds" in the Sept./Oct. issue of *Montana Outdoors* will set you straight. The eight-page, color section will feature outstanding paintings of each species by Missoula artist Ron Jenkins.**

### Excellent "Bear Story"

Mike Aderhold's article, "Grizzly Bear: The Animal, the Symbol, the Enigma," in the May/June 1982 issue, was an excellent piece of journalism. Of all the many "bear stories" I have read, few have been as comprehensive and informative, within the limitations of a magazine article, as Aderhold's.

It would be interesting indeed if we could express our feelings toward the grizzly on the next Montana ballot. I firmly believe the majority of Montana voters would give the great bear a resounding "yes." The problem is turning this mandate into effective action. With all the many demands placed on the bear's habitat, including recreationists, the issue is certainly complex.

Perhaps we'll never see a "grizzly bear initiative" on the Montana ballot. But we can use the democratic process to help the grizzly—through letter-writing campaigns to our public officials and land managers who make the vital decisions concerning the bear's habitat, and by voting for those politicians who champion the preservation of our wildlands.—*Ken Ryder; Bozeman, Mont.*

### Two Sides to the Same Slope

Finally, someone has written an article describing the trials and tribulations of the cross-country skier in the early '70s ("Out of the Closet and Onto the Slopes," Jan./Feb. 1982). As a former resident of Iowa who moved to Montana in the early '70s, I experienced the same problems as Tom Ellerhoff did in his article. As a matter of fact, I thought the article was an autobiography. No one could show me how to pine tar my skis or the techniques for cross-country skiing or waxing. This was all self-taught, using books and much determination.

Cross-country skiing has come a long way since then. I, like Tom, still like wood skis, although they have been repaired many times. Some people ask me why I keep using these skis, telling me that fiberglass skis are the way to go. I respond that these skis are like old friends and the scars on the base are like chapters in a book—each with a story to be told. I really enjoyed the article.—*David W. Johnson, D.D.S.; Great Falls, Mont.*

* * * * *

Despite the Department of Fish, Wildlife and Parks call for help in the March/April 1981 issue of *Montana Outdoors* on the cross-country skiing issue, "Out of the Closet and Onto the Slopes" has done more to discourage skiing in Montana than any other single article I've ever read.

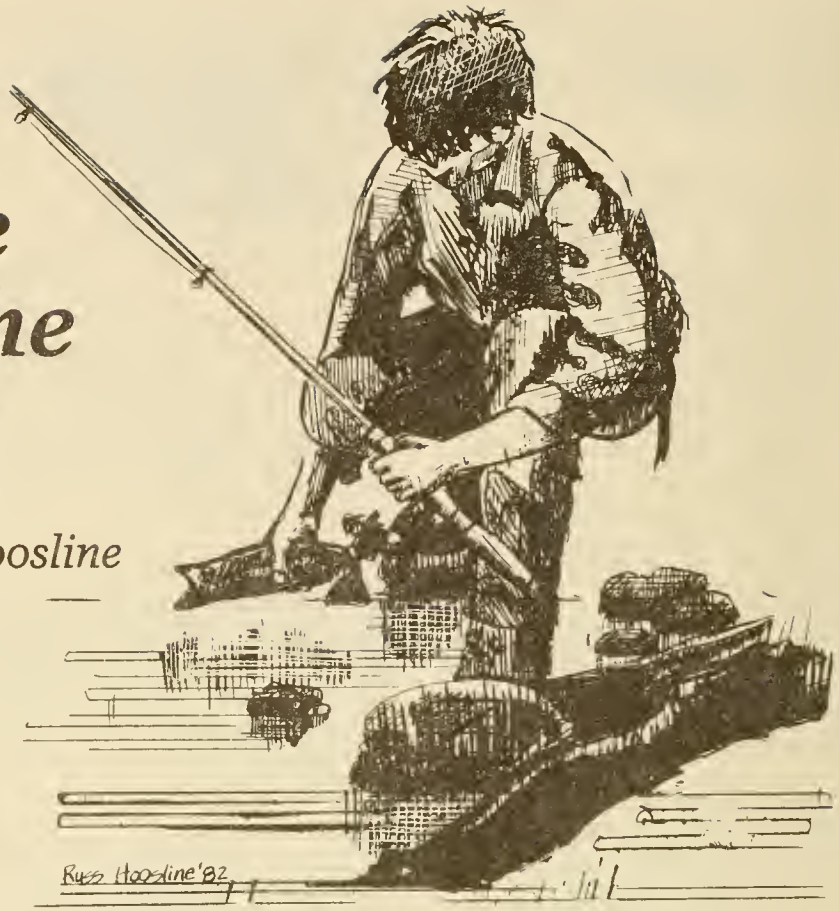
The attempts at what I hope were tongue-in-cheek humor failed miserably and left only a bad taste in my mouth. A paragraph to glance back in time would have been a good way to start the article, but facts should have been included telling of the Nordic skiing world today. The first paragraph was an all-too-feeble attempt to tell this article was about the past, and it was quickly forgotten as the horrors of skiing unfolded. For the beginning skier today, the horrors of pine tar, dusty books, broken skis, and even waxing can be a thing of the past. A person can get into skiing as easily as lacing on a different type of boots. The industry's professionals, both in the ski shops and on the trail, are highly trained individuals. A person doesn't have to spend a day in the high alpine areas to learn the sport; there are touring centers with very competent instructors located throughout the state. These types of things should have been pointed out more specifically in the article instead of as a "by the way" in the very end.

This article should have been reviewed or edited by someone who knew something about skis and waxing so that the information given on why a kicker is used is correct. It is not to make scraping easier, but rather to afford a skier the opportunity for both kick and glide while skiing.

I would have expected nothing less from a magazine that can't tell ski tracks from snowshoe tracks (page 25, Nov./Dec. 1981), but I'm still hoping you can redeem yourselves with a better article in the future.—*Doug Monger; Bozeman, Mont.*

# A Prize Worth the Effort

*by Jon Wongrey*
*illustrated by Russ Hoosline*




THE youthful sun made contact with the high mountain ridge, lighting the crevices still packed hard with the remnants of winter's snow. The sun advanced—coming slowly across the mountain, coloring the rock, and finally succeeding in illuminating the valley with the freshness and unsuspiciousness of a newborn.

A water ouzel bobbed his head up and down as he perched on a rock, catching small fish and insects from the stream's flowing water.

On the far side of the stream, the water eddied into a small, deep pool against the bank. A fly hatch was in progress and the water's surface was marked with the dimples of trout sipping insects. Surely, I thought, kneeling at the water to wash the night's sleep from my eyes, Montana's Bitterroot Mountains suggest the glory of creation.

I wiped my face with the tail of my shirt, turned, and walked over to the early morning fire entrapped in its rock corral. There, my son tended a pan of trout frying over white-ash coals. They sputtered in the hot grease and turned brown, their tails curling up crisp. To the side of the fire, a pot of grits bubbled slowly on a single-burner stove. The smells of cooking grits and sizzling fish mingled with the freshness of the alpine air.

Scooter had gotten up earlier than I and had pulled four cutthroat trout from the stream. He said he took them on a small, black-feathered rooster tail with a yellow body. He told me this as he rested on his knees by the fire, watching the frying fish. A wind came down river and fluffed his blonde air.

We ate in silence, and then had our morning cup of tea. We wished we had brought powdered cream along to cut the tannic acid. We hadn't, and there was no use in continuing to wish we had.

A week had gone by since we left our South Carolina home and passed through the greenness of North Carolina and Tennessee, through the blue-tinted grasslands of Kentucky, and into the flats of Missouri. Missouri bowed to Kansas and her spacious prairies, roomy green cornfields, and acres of freshly mowed wheat. On the afternoon of our first day in Kansas, when the sun was just about to retire, we saw our first cock pheasant, perched on a fence, with his long, pen-shaped tail tucked underneath his gaudy body.

By lantern light that evening in camp, Scooter read aloud from Byron Dalrymple's book, "Sportsman's Guide to Game Fish":

" 'The cutthroat trout is likely to be in a place rather similar to those selected by eastern brook trout—near log or snag, in a deep hole beneath a cutbank. In other words, cuts are fish of somewhat quieter water, and indeed of a quieter disposition, than the rainbow which likes the swift pulsating runs, the white water, and the sturdy riffles.

" 'By and large, the cutthroat may be taken by the same methods used for rainbows. They rise well to dry flies during the early part of the season especially; but they favor wet flies perhaps on the whole more than surface flies, and they are inclined to be less selective at times than rainbows, taking many a gaudy fly that a rainbow might spurn. In fact, many anglers insist that streamers and bucktails for cuts carry at least some white, red, or yellow, or all three in combination.' "

Scooter closed the book and placed it beside him on the warm grass. The sky was black and alive with stars. The hot Kansas wind had subsided, leaving the air breathable again.

"Do you really think we'll get into lots of cutthroats?" he asked, getting up to place another log on the fire.

"I'm sure we will. Everyone I wrote or phoned said the streams and high mountains lakes—especially the mountain lakes—are crammed with cutthroats. Shouldn't be much of a problem to catch a few. You must remember that this land and these fish are as new to me as they are to you," I said.

"Have you ever caught any trout?" he asked.

"Once," I said.

"Where? What kind?"

"On the White River in Arkansas. I was about your age, 15, and I went there with my folks one summer to a place called Mountain Home. I'll never forget the

dash and the wildness of my first rainbow as it broke the surface, hurtling itself into the air. I caught six that morning."

"Do you think we'll catch any rainbows?" he asked.

"I would think so. What does Dalrymple have to say about rainbows?"

He thumbed through the book and again read aloud: " 'Rainbow trout strike hard as a rule, and...' "

"Sorry to interrupt, but that's the way I remember those rainbows I caught—fighting a swift, headlong battle. Continue."

" 'The rainbow is a good dry-fly fish. The patterns it will take are legion. It is foolish to give advice on them here. The plain fact is, what will catch a rainbow in one place will usually catch a rainbow thousands of miles away.

" 'Streamers, bucktails, numerous wet flies, and nymphs are proper rainbow lures. In fact, there are places where large rainbows feed hardly at all on the surface and must be fished, if one is to have reasonable success, with underwater lures.

" 'As fine a fish as the rainbow is, it must be admitted that like all trout it is gullible for a still-fished bait, will take cut bait, live and dead minnows, and even corn and dough-balls. The top rainbow baits in most areas are nightcrawlers or angleworms,' " he read, and closed the book.

"Sounds good," I said.

"How much farther is it to Montana?" he asked.

"Far enough that Montana still exists only in our dreams. We'd better get some sleep," I said, dousing the fire.

Montana had been a year in the planning. It began when I told Scooter that if he did exceptionally well in school, I would take him somewhere special the following summer. He did, and I held true to my promise.

I hoped my choice was right. I hoped that Montana would become more than Scooter or I could dream, for I knew absolutely nothing about where we were going except that we were many miles from South Carolina and heading for the Bitterroot Valley town of Darby, Mont.

I dreamed that night of Arkansas' White River and of those high-leaping rainbow trout.

The drudgery of Kansas' seemingly shoreless boundaries surrendered the next day at noon when a portrait of mountains came into range—hazy at first, then confirmed as the Rockies. Kansas ended, and Colorado began as we followed these noble mountains. Wyoming came, and we sighted pronghorn antelope grazing on the hillsides. We discussed briefly the fact that pronghorns are not really antelope nor are they even closely related to the antelope family, but that the pronghorn is unique, truly an American mammal, and the sole representative of its genus.

Wyoming soon became just another conquered state and into Idaho we ventured, where roadside streams kept us company and abandoned homesteads raised our curiosity. The hills again matured into mountains as we navigated the high mountain passes.

Montana. It was as the books and postcards praised her—grand!

We came out of the mountains and down into the Bitterroot Valley where summer was still a novelty. You see, Montana's last mountain snows had ceased only in July. Come September, the first frost would return, and soon the snows. It was now the second week of August.

We had arrived and, for the first time, we thought that perhaps 2,515 miles was a bit far to go to catch trout. But then the land recaptured and subdued our thoughts and all we cared about was getting into the mountains and fishing the streams and mountain lakes.

Concern for time and distance was totally erased as I cleaned our plates and broke camp while Scooter again fished the stream, catching and releasing cutthroats—even cutthroats not three inches long were hooking themselves fast to the rooster tail's treble hooks.

I lashed the tent to my pack and went down to the stream to refill the water jugs. The water we would carry would have to last until we descended to Kerlee Lake.

Scooter was busy unhooking the bait from the tender mouth of another just-caught cutthroat as I filled the first of four canteens. He bent low to the water and submerged his catch until the fish regained composure. The released fish flicked its tail once and went home again to swift water and deep, restful pools.

"Time to saddle up," I said.

Packs on our backs, we continued our walk into the pith of the Bitterroot Mountains.

The trail took us close to a rock wall—its stone facing was stained from rivulets of water trickling down through the ages. There we stopped and leaned against the wall's cool moistness to rest.

"Much farther?" Scooter asked, panting.

"Maybe a mile and straight up; straight up to the stars it seems," I said, bending over low to ease the pain in my shoulders inflicted by the weight of the pack.

"Is it worth it?" he asked.

"Is what worth it?" I asked.

"This trip," he said.

"At the moment, no. But it will be once we reach the lake of our dreams. We've worked too hard for it not to be," I said.

"It's just rougher than I thought it would be," he said.

"Me too. Want some water?"

"No, sir."

"You did bring Dalrymple's book?"

"Sure," he answered.

"Good. Do you think you can walk a bit faster?"

"I'll try," he said, "but I really don't see how. I'm bushed."

"Maybe we should have trained harder," I said. "Goodness knows, I thought running six miles a day would have been more than enough to see us through this trip. I guess not."

Resting, I thought about these mountains and their grandness and the more I meditated the more I realized I had never been acquainted with anything to compare them to. In some ways, they were still the final trial of strength.

We went higher. The deep woods receded, thinning as we gained elevation. The gushing stream no longer kept us company and its companionship was missed. Our fellowship was now with the mountain winds.

We would reach the first lake of our conquest. Lake Kerlee is a beautiful lake, embraced with thick green grass and blossoming flowers. Mornings there are soft; the afternoons are pleasant, and the nights soothing in a land where silence is sometimes noisy. The water is clear and there we fished and watched as trout came from the deep to attack moving baits. They were mostly cutthroats, but occasionally a rainbow would rise and sip a dry fly.

Two days later, we descended from Kerlee and moved deeper into the mountains to Tin Cup Lake. And from Tin Cup we crossed the Continental Divide and fished Idaho's Triple Lakes. Cutthroats greeted us there, as they had at Tin Cup.

A storm came one afternoon to Triple Lakes and when it had finished, the sun returned as an old friend coming home. The trout gorged themselves on insects. That night we feasted on coal-baked cutthroats. It was the night before our departure. We fed the fire until tomorrow became today.

"Well," I said, serving up a cup of hot tea.

"Yes. It's what I thought it would be," he said.

"Was the prize worth the effort?" I asked.

"Yes, sir," he said.

"No disappointments?"

"None," he answered.

"That makes it perfect."

"I know."

I eased into sleep, knowing that one day I would dream about Montana and her cutthroats, as I had about the White River of Arkansas and its rainbow trout. ■

# Contributors

• A site near Choteau is one of the world's most important dinosaur repositories. Eggs, babies, embryonic bone, and juveniles and adults of several different types of dinosaurs—including duckbills—have been found. Although it will be years before the excavation and preparation are complete, the discovery will remain in Montana, housed at a new paleontology museum at the Museum of the Rockies in Bozeman. The prehistoric dinosaur remains will be "Coming Home to Roost." For the history of this intriguing site, turn to **Jack Horner's** article on page 2. Formerly with Princeton University, Horner is curator of paleontology with the Museum of the Rockies.

• Illustration for the dinosaur article was done by **Doug Henderson**, Bozeman. Henderson is working on the art for the museum exhibits with Horner and will accompany the excavation team to the Choteau site this summer to prepare on-site drawings and paintings.

• What most of us call "water weeds" go by the more technical name of aquatic macrophytes. We most often encounter them wound around the blades of our outboard motors, or tangled around the hooks at the ends of our fishing rods. But as **Paul Garrett** writes, they also perform many important, beneficial functions. "Of Water, Weeds, and Man" begins on page 6, and a section of it focuses on the problems with water weeds at Georgetown Lake, a popular recreational area near Anaconda. Garrett, who lives in Helena, is project manager at Georgetown for the Environmental Protection Agency's Clean Lakes Study.

• The most common intestinal parasite in the United States can make you very sick. *Giardia* is not anything you can see, and it could very well be living in the water you gulp from a clear, cascading mountain stream. As **Christine Deveny** states, "No magic potion, inoculation, or medicine can prevent giardiasis." But you can prevent contamination of water supplies by utilizing proper backcountry hygiene in disposal of body wastes, and you can also follow precautions recommended by Deveny when you drink water in backcountry. "Don't Risk the Water" starts on page 8. Deveny is an environmental health specialist and registered sanitarian with the Lewis and Clark City-County Health Department in Helena.

• "The 'Bloody Nuisance' That Bites," the mosquito harasses outdoor recreationists throughout Montana and on a global basis reduces much of mankind to "hopeless lives of poverty and chronic illness." Small wonder, considering that one female mosquito's offspring, under ideal circumstances, could number up to 20 million individuals in only five generations. Turn to the article, by **G. Wesley Burnett** and **Lisa Mathis Butler**, on page 15. Burnett, formerly with the department's Parks Division, is an assistant professor of Recreation and Park Administration at Clemson University in South Carolina. Butler earned a graduate degree in Recreation and Park administration from Clemson and currently is a doctoral student in geography at the University of Oklahoma.

• A change in fisheries management came about in western Montana when biologists realized that many better trout streams could probably produce more larger trout if given the opportunity. Some new regulations emerged; among them is the "five trout, only one over 14 inches" section. Although it's too early to evaluate effects of these regulations, "The Rock Creek Experiment," launched in 1979, might provide insight into possible success of the 1982 regulations elsewhere. Turn to **Don Peters'** article on page 20. Peters is a fisheries biologist working from the department's Missoula office.

• As **Jon Wongrey** and his son "Scooter" hiked deeper and deeper into the "pith of the Bitterroot Mountains," they both wondered if the trout they were seeking would be "A Prize Worth the Effort." Fellowship with the mountain winds, the mountains as the final trial of strength, lakes with clear water, and trout coming from the deep to attack moving baits proved indeed to be prizes worth the effort. Wongrey is a free-lance writer living in Sumter, S.C. Formerly a reporter for a newspaper in Columbia, S.C., he has been a free-lancer for several years and has over 150 magazine articles and three cookbooks to his credit. His article begins on page 24.

• The pen-and-ink accompanying "A Prize Worth the Effort" is by **Russ Hoosline**, who works in advertising sales for the Helena Independent Record. He previously was employed by the Billings Gazette in its graphics department. His interests include commercial art, painting, drawing, and graphics of all kinds.

• Folks in northwestern Montana call them silver salmon, little redfish, or "Flathead's Bluebacks." Whatever you call them, kokanee have become the "bread-and-butter" fish of the upper Flathead. When a cry of "The salmon are in!" rings across the valley, people, rods, and buckets fly into pickups and the race is on for a spot on the bank. To explore questions such as—What has caused the decline of kokanee spawning along the shore of Flathead Lake? How much flow is needed in the Flathead River to maintain a healthy kokanee population?—turn to **Patrick Graham's** article on page 27. Graham directs department fisheries research in the Flathead Lake and River Basin. He is a member of the Scientific Advisory Committee to the Pacific Northwest Power Planning Council.

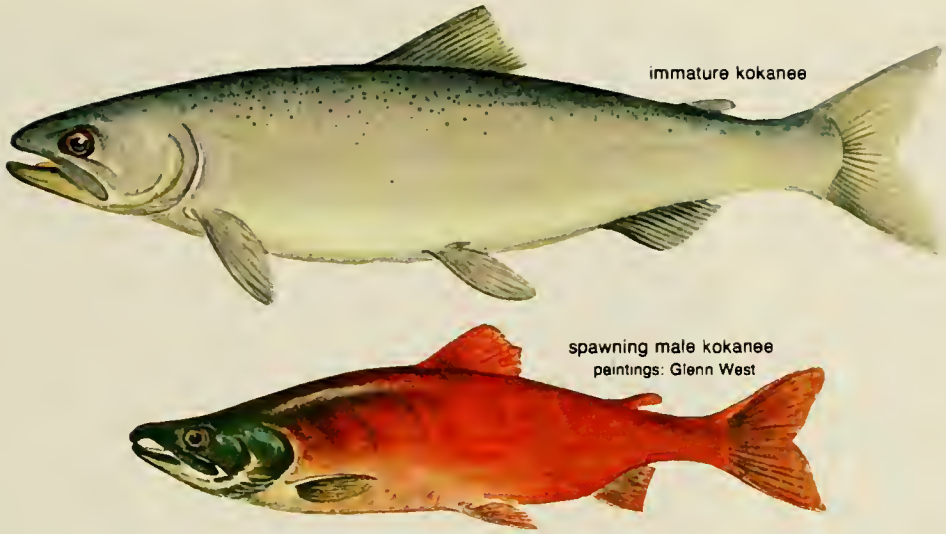
• If **Ken Walcheck** could live his life over as anyone he chose, he might well select Meriwether Lewis. They share a boyhood fascination with plants, extensive knowledge of natural history, and the ability to see little things often overlooked, even by experienced observers. Lewis truly was a biological "on-the-scene" reporter without equal, and his observations are the basis for Walcheck's article "With Pen and Plant in Hand" (page 30). Walcheck continues his duties as the department's information officer in Miles City.

• **Shirley Cleary's** primary medium is gouache, an opaque watercolor technique. Its effectiveness is displayed in her front cover painting of a fly fisherman. She says of her art: "My work deals with subjects that are important to me and my life. When I moved to Montana, it was to be with the outdoors and to fish." Her work can be seen at her studio at 1804 Beltview and at Tatem House, Helena; Bud Lilly's, West Yellowstone; Wild Wings, Bozeman; Gallery 85, Billings and Hole in the Wall, Ennis, as well as at Carson's Gallery of Western Art, Denver; The Sportsman's Edge, Inc., New York City, and The Sportsman's Gallery, Houston.

• The stylized, vibrant watercolor, "Kokanee in Motion," was prepared especially for this issue by **Kendahl Jan Jubb**, Missoula. She has worked with watercolor for eight years and has had exhibitions throughout Montana, as well as in Portland, Los Angeles, and Bethesda, Md. The Danforth Gallery, 106 N. Main, Livingston, will exhibit a series of her paintings July 18-August 18. Her work can also be seen at Bebe Kezar, Whitefish.

• *Montana Outdoors* extends special thanks to **Larry Thompson** of Helena for his continuing contributions to the magazine. His work in this issue includes the colorful *Orthocarpus* on the inside front cover and the pen-and-inks illustrating "With Pen and Plant in Hand." He is biological sciences coordinator for the Facility Siting Bureau of the Department of Natural Resources and Conservation.

• Our appreciation to the following photographers: **Ron Aasheim**, Helena; **Mike Aderhold**, Kalispell; **Dean Biggins**, Sheridan, Wyo.; **Ad Clark**, Kalispell; **Larry Dech**, Grand Haven, Mich.; **Diane Ensign-Caughey**, Whitefish; **George Kirsch**, Anaconda; **Jerry Manley**, Butte; **Tom Maurer**, Bozeman; **Jim Romo**, Corvallis, Ore.; **Steve Wirt**, Whitefish, and **George Wuerthner**, Missoula.




# Flathead's Bluebacks

## by Patrick Graham

*"During the 1930s, we took part in an experience that will never be repeated in our lifetimes... dip netting whitefish out of McDonald Creek in Glacier Park. As I remember, it took place in October as there was sometimes snow on the ground.*

*"When it was good and dark, we lighted up the old lantern, grabbed the long-handled dip net, and waded into the creek. Light coming from a small unblacked spot on the chimney of the lantern threw a narrow beam of light onto the fast moving water... this was just enough light to see the fish swimming up the stream and not enough to scare them away.*

*"When we were first allowed to dip net up there, in about 1934 or 1935, we could take home all the fish we could get, but the next year the Park Service cut the amount down to 50 per day for a couple years and all of a sudden no one was allowed to dip net, so our fun was finished.*

*"Before I end, I must tell you about the first time we knew kokanee salmon were in Lake McDonald. One morning, we emptied our sack of fish, and there was one of them in with our nice trim whitefish... it was a male in its last stage of life with that freakish upturned jaw. Dan phoned the ranger and he couldn't believe it. The Park was really wrought up about those fish moving in, as they were not one bit popular at the time."* (excerpts from a letter from Doris and Dan Huffine, long-time Flathead Valley residents, to Department of Fish, Wildlife and Parks biologist John Fraley, 1981)

* * * * *

Kokanee, a landlocked form of the Pacific sockeye salmon, are sometimes called bluebacks, little redfish, or silver salmon. Although they are not native, they are presently found in many lakes in western Montana. They were initially reported in 1918, but no official records exist of the first kokanee introductions.

Chinook salmon eggs from Oregon were reportedly stocked in Lake Mary Ronan and Foy Lake in 1916. Two years later, a department seining crew in Lake Mary Ronan was surprised to find blue-backed salmon in the nets. Apparently, kokanee eggs had been mixed in with the chinook eggs. In 1919, mature kokanee were also found in a bay of Flathead Lake, although no introduction had been reported.[1]

By 1933, thousands of kokanee were spawning along the east and west shores of the lake, and heavy runs were ascending the Flathead and Swan rivers. That year, sportsmen took an estimated 100 tons of kokanee from Flathead Lake. That would be over 200,000 salmon!

Not everyone was pleased about their success, however. A National Park Service biologist referred to the first salmon caught in McDonald Creek as a "nongame" fish called "little redfish" or, more commonly, "yank" fish.[2] As described, "the name was derived from the fact that when abundant they congregate in great numbers at the mouth of a stream before running to spawn, where they are taken with unbaited hook on a line or wire, the tackle being lowered to the bottom and then 'yanked' upwards hooking the fish."

Reference to kokanee is infrequent until the early 1950s when a department biologist reported seeing schools of kokanee spawning in the fall as he flew along the shore of Flathead Lake. He investigated the spawning sites further and observed that many eggs were exposed because the water level in the lake dropped over the winter due to drawdown from Kerr Dam. This was the first reported concern about kokanee reproduction in the Flathead. It is a concern that is growing.

Today, kokanee are the "bread-and-butter" fish in the upper Flathead Valley. When September arrives, many people turn their thoughts to cutting wood or bugling elk. Summer is gone, and many fair-weather anglers hang their poles for another season. But in the Flathead, it is just beginning.

"The salmon are in!" It rings from sport shop to street corner. In a frenzy, people, rods, and buckets fly into the pickup. Trails of dust drift across the river as yet another bunch hustle for their spot on the bank.

A few salmon porpoise off shore and quickly are bombarded with lead-weighted treble hooks, a modern version of "yanking." The kokanee can be taken on lures early in the run, but

Migrating out of Flathead Lake into the Flathead River to spawn, kokanee take lures early in the run but more commonly are taken by snagging (DFWP photo: Beth Morgan).

are most easily captured by snagging as they migrate up the river on their spawning run.

After they enter the river, the kokanee age very quickly as the chemical make-up of their bodies changes. A large hump forms on the male's back, his color changes from grey-blue to red, and the lower jaw hooks as it enlarges. Within several weeks, both males and females will die as their lives culminate in the single, final act of spawning.

Kokanee school close together and provide a bountiful catch when a school is located. Thousands of kokanee enter the river in September and October. They appear to move through the river in waves, each wave made up of many small schools. The earliest migrants are destined for McDonald Creek in Glacier National Park, presently the largest spawning area in the Flathead. In 1981, biologists observed nearly 100,000 salmon while snorkeling in the creek.

Over the years, the beginning and duration of the migrations have varied considerably. In 1980, the run came in late and moved through quickly; as a result, fishing was poor. In some years, McDonald Creek is too warm when salmon reach its mouth, so they concentrate in the Middle Fork of the Flathead—and fishermen line up to fill their buckets.

In November, later runs of kokanee spawn in the main Flathead River downstream from its confluence with the South Fork of the Flathead River. Water temperature in this area is moderated by water discharged from Hungry Horse Dam. (Kokanee need the warmer water during their first month in the gravel to survive.) Other spawning in the Flathead River Basin is limited to areas with temperature-moderated springs.

Construction of Hungry Horse Dam in 1953 provided additional spawning habitat in the main Flathead River for kokanee because the reservoir discharged warmer water during critical stages of incubation; this allowed the number of kokanee to increase from the 1960s through the early 1970s.

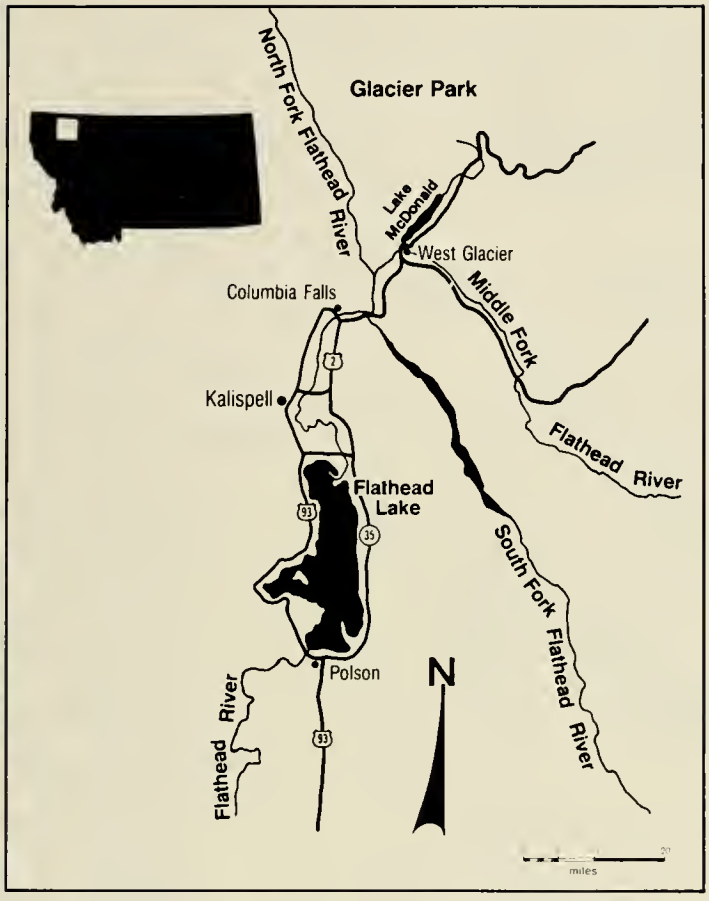
Spawning also occurs along the shore of Flathead Lake in areas near groundwater or seeps but, as pointed out earlier, drawdown by Kerr Dam, constructed in 1938, limits the amount of habitat available. Most kokanee spawn in the upper 15 to 20 feet of the lake which is drawn down up to 10 feet each year. Other factors may also contribute to declining lakeshore spawning populations.

The dying kokanee are important beyond their value to fishermen. Each year, hundreds of eagles on their southern migration stop at McDonald Creek and along the Flathead River to feed on kokanee. Biologists at Glacier Park believe this is one of the most important feeding stops along the eagles' 800-mile migration route. The eagles perch along the stream and dive into riffles, generally capturing weak salmon after they have spawned. Some biologists believe the number of eagles and their length of stay is related to the size of the spawning run. If so, measures which could ensure a stable run into McDonald Creek and increase the run into the main Flathead River would benefit both eagles and fishermen.

There is evidence that kokanee begin to school soon after they reach the lake, and they continue to school throughout life. Each day, they migrate vertically in the lake to feed near the surface at day, then drop down to deeper water after dark. Zooplankton are their only food source, although fishermen capture them on lures.

A fisherman will tell you a kokanee has a soft mouth, so it requires a delicate approach to hooking and landing. Feeding on microscopic organisms has not necessitated development of the strong mouth and jaws that other species need to feed on insects or other fish.

Since they school in open water and depend on a single food source, their often large numbers can directly influence their growth. Competition for food exists within and between schools. So, large numbers of fish mean smaller fish. While this phenomenon is not unique to kokanee, it is more apparent than in stream fisheries where competition for food and space often results in displacement of




less dominant fish. Variations in the size of kokanee from year to year are also more apparent because they die after spawning.

The fishery exists on the spawning run to harvest the excess or spawned-out kokanee. When kokanee numbers are large, limits are liberal. When the numbers are small, as they have been for several years, the limit and season are reduced.

But it is not the fisherman who caused the present decline in the kokanee population. It was the change in operation of Hungry Horse Dam. In the early years, the dam usually stored water through the fall, keeping the river low and the kokanee eggs wet all winter.

More recently, water has been discharged by the dam during the fall, allowing kokanee to spawn higher on the bank. Later in the winter, flows were cut back leaving eggs high and dry. Many eggs died due to freezing or drying, and the salmon decreased in numbers and increased in size.

To answer the question of balance means providing not the maximum but the optimum number of fish. This requires a measured increase in the number of spawners in the main river and, if possible, around the lakeshore.

How do we do that? First, we examine our past. Since the mid-1960s, Laney Hanzel, department fisheries biologist in Kalispell, and others have monitored the kokanee in Flathead Lake. They have helped to build a much-needed historical record, using an aging ocean trawler, the *Dolly Varden,* and sophisticated electronic gear.

When plans to increase peaking power at Hungry Horse Dam and the potential for a reregulating dam were announced by the Bureau of Reclamation, they provided us with funds to study the river run of salmon. Department fisheries biologist John Fraley succeeded Steve McMullin in conducting research which has led to determination of flows needed to develop and maintain a healthy kokanee population in the Flathead River. Flows were provided to protect salmon eggs the past two years and, with cooperation, could be permanent. We will continue to study migration and spawning habits while the population stabilizes.

Recently, department biologists have begun to look at reasons for the decline of kokanee spawning along the shore of Flathead Lake. This study was funded by the Bonneville Power Administration in conjunction with the new Northwest Power Planning Act (which calls for a regional look at the impacts of hydro-system regulation on fish and wildlife). Department fisheries biologist Janet Decker-Hess is conducting the research to unravel the factors that contributed to the decline of lakeshore spawning.

A related study was initiated two years ago because of concern over effects on the Flathead system of a proposed coal mine on Cabin Creek in the upper North Fork. A portion of the study, funded by the Environmental Protection Agency, identified food habits of major sport fish, including kokanee, to better predict how pollution from the mine would affect them. Data from this study, conducted by department fisheries biologist Steve Leathe, gained significance because final plans were recently submitted to the Canadian government to develop a huge open-pit coal mine on the North Fork of the Flathead River.

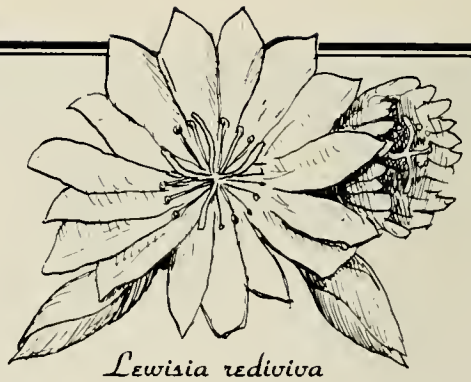
The study also turned up the first recorded *Mysis relicta,* or opossum shrimp, in Flathead Lake. *Mysis* were introduced into other lakes in the system a number of years ago in the expectation they would provide food for kokanee. Now department biologists are concerned that *Mysis* may compete for food with kokanee. It will take a number of years before the *Mysis* population expands and the consequences can be evaluated.

The story of bluebacks in the Flathead continues to unfold. Now so intertwined, it is hard to imagine one without the other. The "small unblacked spot on the chimney of the lantern" continues to throw only a narrow beam of light into their future. ■

### REFERENCES


[1] Alvord, William, unpublished manuscript, "History of Fisheries Activities in Montana," Montana Department of Fish and Game, undated.

[2] Personal communication from David H. Madsen, supervisor of Fish Resources, USDI, National Park Service, to E.T. Scoyen, superintendent, Glacier National Park, Dec. 7, 1935.



*Lewisia rediviva*

ON THE June day I broke ties with the sixth grade, a group of us pedaled our bikes down to the river to prepare for an ambush in the bordering cottonwoods. We were members of a posse, with imaginary six-shooters trained on the Hole-in-the-Wall gang lurking in the sagebrush across the river. When they made their move to ford the river, we would spray the air with lead and blast them off their horses.

"They'll be sorry they came into Montana territory," we boasted, hunkering behind some fallen cottonwoods. "C'mon ahead, you varmints!"

Well, the gunslingers never came, and fighting imaginary outlaws soon gave way to hunger pangs which were not imaginary. One of our gang suggested we dig up some prairie "turnips" to tide us over. He read somewhere that Lewis and Clark had eaten them when they passed through what is now Montana.

We managed to find some prairie turnips, but I truthfully can't remember how they tasted or if they eased our hunger. And I never thought of the prairie turnip again until I began researching the Lewis and Clark journals for information about their botanical observations in Montana. I was pleasantly surprised to find that Meriwether Lewis was particularly impressed by an edible member of the pea family, called "white apple" or "prairie turnip" (*Psoralea esculenta*). On May 8, 1805, near the mouth of the Milk River, Lewis wrote a detailed description of the plant, including how the Indians used its roots in cooking.

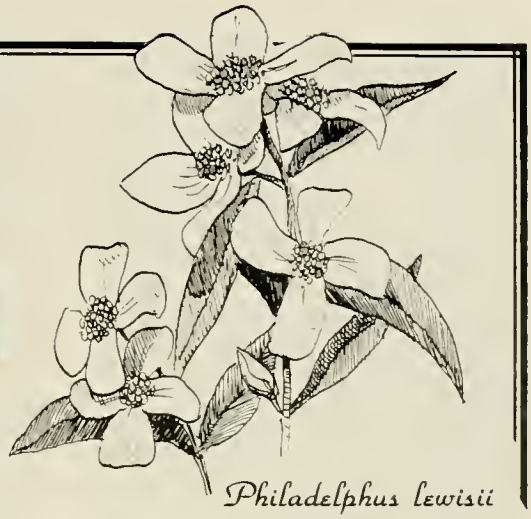
The 1804-06 Lewis and Clark expedition has been well-documented as a classic in the vast literature of discovery and exploration, but the full scope of its scientific accomplishments—such as the botanical contributions—has never fully been appreciated. The primary objective of the expedition was to explore the Missouri River and other western rivers with the goal of finding "the most direct and practicable water communication across the continent for purposes of commerce." From a diverse and complex array of assignments emerged an incredible accumulation of scientific information. In his detailed letter of instruction to Lewis, President Thomas Jefferson directed that he keep track of the flora across the continent and take note of the "vegetable productions" of the land, the dates on which various plants put forth their flowers, the quantity and distribution of vegetation, and the kinds of wild or cultivated plants that provided food for the Indians.

An examination of Reuben Thwaites' "Original Journals of the Lewis and Clark Expedition, 1804-1806" clearly shows that Lewis made a conscientious effort to record as much information as circumstances permitted. Considering the difficulties of travel and the problems of survival, it is difficult to imagine how he found time to document as much as he did.

Needless to say, the journals contain a wealth of botanical information, fruits of close, continued attention, ranging from a running commentary on plant life encountered across the continent to detailed descriptions of individual plants. The following is a classic example of what Lewis, biological on-the-scene reporter, could do with a currant plant in one hand and a pen in the other (July 18, 1805, about three

# With Pen & Plant in Hand

by Ken Walcheck
illustrated by Larry Thompson



*Philadelphus lewisii*

miles below the mouth of the Dearborn River):

> there are a great abundance of red yellow perple & black currants, and service berries now ripe and in great perfection. I find these fruits very pleasent particulary the yellow currant which I think vastly preferable to those of our gardens. the shrub which produces this fruit rises to the hight of 6 or 8 feet; the stem simple branching and erect. they grow closely associated in cops [copse] either in the oppen or timbered lands near the water cou[r]ses. the leaf is petiolate of a pale green and resembles in it's form that of the red currant common to our gardens. the perianth of the fructification is one leaved, five cleft, abreviated and tubolar the corolla [calyx] is monopetallous funnel-shaped, very long, superior, whithering and of a fine orrange colour. five stamens and one pitillum; of the first, the fillaments are capillare, inserted into the corolla, equal, and converning; the anther ovate, biffid and incumbent. with rispict to the second the germ ovary is roundish, smo[o]th, inferior pedicelled and small; the style, long, and thicker than the stamens, simple, cylindrical, smooth, and erect, withering and remains with the corolla untill the fruit is ripe. Stigma simple obtuse and withering. the fruit is a berry about the size and much the shape of the red currant of our gardins, like them growing in clusters supported by a compound footstalk, but the penduncles which support the several berries are no longer in this species and the berries are mor scattered. it is quite as transparent as the red current of our gardens, not so ascid, & more agreebly flavored. the other species differ not at all in appearance from the yellow except in the colour and flavor of thier berries.

In his description, Lewis used 18 technical botanical terms. The use of such terminology indicates he was well-versed in botanical language, as well as being extremely observant. If Lewis could adequately describe a plant by just looking at it, one has to speculate what more he could have done with a binocular dissection microscope currently used in scientific laboratories.

It was no accident that Lewis was an unusually competent botanist, even though he lacked a formal education in the natural sciences. His botanical knowledge was a blend of a boyhood fascination with plants, fortified with information gleaned from his mother, a practicing herbalist. In addition, Lewis served as President Jefferson's private secretary for two years and had access to the president's fine library which contained many books on natural history. Before the expedition departed, Lewis also studied with several distinguished scientists, including Benjamin S. Barton, professor of botany at the University of Pennsylvania. Thus, he acquired at least a rudimentary understanding of nearly every branch of science considered important in conducting the exploration.

Meriwether Lewis has been described as a naturalist, and he was an extraordinary one. But that's like calling Charlie Russell a painter. You have only part of the man. Lewis was a remarkable man in many disciplines.

Not only was he an excellent reporter, he was also particularly adept at seeing little things so often overlooked, even by experienced observers. An example is an isolated pocket of limber pine (*Pinus flexilis*) bordering the Missouri River near Eagle Creek. I float this stretch of the Missouri every July with an outdoor recreation class from Northern Montana College in Havre. We have floated the river for 10 years now, and never has a student commented on the presence of limber pine in this area, even though it is quite conspicuous. I am sure most students assume they are looking at ponderosa pine (*Pinus ponderosa*) which also grows in the area.

Despite the numerous hardships of traveling upstream in this particular reach of the Missouri, Lewis mentioned the limber pine on May 31, 1805:

> on these clifts I met with a species of pine which I had never seen, it differs from the pitch pine in the particular of it's leaf and cone, the first being vastly shorter, and the latter considerably longer and more pointed.

Lewis is not referring to ponderosa pine which he had already noted on May 11, 1805:

> saw$_d$ today some high hills on the star$^d$. whose summits were covered with pine. Capt Clark went on shore and visited them; he brought with him on his return som of the boughs of this pine. it is of the pitch kind but I think the leaves somewhat longer than ours in Virginia.

Another astute ecological observation focused on western wheatgrass (*Agropyron smithii*). Traveling

Rocky Mountain iris (DFWP photo: George Kirsch)

through the plains country of the Columbia River Basin, Lewis observed this grass appeared to be as nutritious in its dry winter condition as during the summer. He reported some of the horses that had wintered on this grass were as "fat as seals," in spite of being well-ridden. An authority on western flora, C.V. Piper, would later report that bunch grasses of the genus *Agropyron* were known for retaining their nourishment after curing on the ground, and that Lewis deserved credit for his keen observation.

Because Lewis was entrusted with caring for the health of the men, he was always alert for plants with medicinal value. The fact that a physician did not accompany the expedition and that both Lewis and William Clark practiced medicine rather systematically among both enlisted men and Indians with whom they came into contact made their journey of great interest to latter-day physicians and botanists. Utilizing the contents of their medical kits, the two treated boils, abscesses, callouses, bunions, sore feet and backs, sunstroke, dysentery, fatigue, colds, fevers, toothaches, venereal disease, headaches, colic, pleurisy, and rheumatism. Lewis and Clark drew upon their medical supplies, but if some were unavailable or if the medicine did not produce the desired result, they did not hesitate to use plants. An excellent example of Lewis' willingness to experiment with native plants for medicinal purposes occurred in early June 1805, when the

silvery lupine (photo: Diane Ensign-Caughey)

expedition left the mouth of the Marias River in spite of Lewis being "somewhat unwell with the disentery." On June 11, 1805, he wrote:

> This morning I felt much better, but somewhat w[e]akened by my disorder. at 8 A.M. I swung my pack, and set forward with my little party. proceeded to the point where Rose River a branch of Maria's River approaches the Missouri...I determined to take dinner here, but before the meal was prepared I was taken with such violent pain in the intestens that I was unable to partake of the feast of marrow bones. my pain still increased and towards evening was attended with a high fever; finding myself unable to march, I determined to prepare a camp of some willow boughs and remain all night. having brought no medicine with me I resolved to try an experiment with some simples; and the choke cherry which grew abundantly in the bottom first struck my attention; I directed a parsel of the small twigs to be gathered stripped of thier leaves, cut into pieces of about 2 Inches in legnth and boiled in water until a strong black decotion of an astringent bitter tast was produced; at sunset I took a point [pint] of this decotion and ab[o]ut an hour after repeated the d[o]ze by 10 in the evening I was entirely releived from my pain and in fact every symptom of the disorder forsook me; my fever abated, a gentile perspiration was produced and I had a comfortable and refreshing nights rest. This morning I felt myself quite revived, took another portion of my decotion and set out at sunrise.

blueflax (photo: Thomas Maurer)

As the expedition traveled through Montana, Lewis graphically described vegetative landscapes and numerous plant species. If one had the patience to extract and piece together all of Lewis' botanical notes on Montana flora, one could construct a travel brochure that would provide today's visitor with a good account of what he or she could expect to see. Such descriptive narratives were extremely important to those who later opened up the West for settlement.

Lewis' eye was contantly alert for those plants with food value. Lewis described native plants on which the Indians and members of the expedi-

# Plants Collected in Montana

The following is a list of those plant species collected in Montana by Meriwether Lewis and preserved in the Lewis and Clark Herbarium of the Academy of Natural Sciences in Philadelphia. Also included (p. 35) is a list of plants described in Montana by Lewis, but not collected and not previously documented. It is probable that Lewis provided the first documentation for those species. There has been no attempt to list all of the plants mentioned by Lewis in Montana because inadequate descriptions often provide an insufficient basis for identification.

| Scientific Name | Common Name | Date | Location |
|---|---|---|---|
| *Atriplex nuttallii* | Nuttall saltbush | July 20, 1806 | somewhere below forks of Marias River, Pondera or Toole counties |
| *Balsamorrhiza sagittata* | arrow-leaved balsamroot | July 7, 1806 | Lewis and Clark Pass, Lewis and Clark County |
| *Euphorbia marginata* | snow-on-the-mountain | July 28, 1806 | somewhere on the lower reach of the Marias River, Chouteau County |
| *Gaillardia aristata* | gaillardia | July 6, 1806 | west of Lewis and Clark Pass, Powell or Lewis and Clark counties |
| *Hordeum jubatum* | foxtail barley | July 12, 1806 | near mouth of Sun River, Cascade County |
| *Iris missouriensis* | Rocky Mountain iris | July 5, 1806 | vicinity of Blackfoot River, probably Missoula County |
| *Juniperus communis* | common juniper | July 7, 1806 | Lewis and Clark Pass, Lewis and Clark County |
| *Lewisia rediviva* | bitterroot | July 1, 1806 | mouth of Lolo Creek, Missoula County |
| *Linum lewisii* | blueflax | July 9, 1806 | vicinity of Sun River near Great Falls, Cascade or Lewis and Clark counties |
| *Lonicera involucrata* | twin-berry honeysuckle | July 7, 1806 | Lewis and Clark Pass, Lewis and Clark County |
| *Lupinus argenteus* | silvery lupine | July 7, 1806 | Lewis and Clark Pass, Lewis and Clark County |
| *Mimulus guttatus* | common monkeyflower | July 1, 1806 | mouth of Lolo Creek, Missoula County |
| *Oenothera caespitosa* | tufted evening primrose | July 17, 1806 | Great Falls area, Cascade County |
| *Orthocarpus tenuifolius* | thin-leaves orthocarpus | July 1, 1806 | mouth of Lolo Creek, Missoula County |
| *Pedicularis groenlandica* | elephanthead pedicularis | July 6, 1806 | headwaters of Blackfoot River, near Lewis and Clark Pass, Lewis and Clark County |
| *Pedicularis scopulorum* | lousewort | July 6, 1806 | headwaters of Blackfoot River, near Lewis and Clark Pass, Lewis and Clark County |
| *Petalostemon purpureum* | purple prairie-clover | July 22, 1806 | near Cut Bank Creek, probably Glacier County |
| *Philadelphus lewisii* | mock-orange | July 4, 1806 | vicinity of Blackfoot River, near Missoula, Missoula County |
| *Psoralea esculenta* | breadroot scurfpea | May 8, 1805 | described near mouth of Milk River, but probably collected in North Dakota |
| *Purshia tridentata* | bitterbrush | July 6, 1806 | west of Lewis and Clark Pass, Lewis and Clark County |
| *Ribes aureum* | golden currant | July 29, 1805 | vicinity of Three Forks, Gallatin County |
| *Sarcobatus vermiculatus* | greasewood | July 20, 1806 | below forks of Marias River, probably Glacier County |
| *Sedum stenopetalum* | yellow stonecrop | July 1, 1806 | mouth of Lolo Creek, Missoula County |
| *Shepherdia argentea* | silver buffalo-berry | July 6, 1806 | west of Lewis and Clark Pass, Powell or Lewis and Clark counties |
| *Sphaeralcea coccinea* | scarlet globemallow | July 20, 1806 | near the forks of Marias River, probably Glacier County |
| *Stipa comata* | needle-and-thread grass | July 8, 1806 | above headwaters on North Fork of Dearborn River, Lewis and Clark County |
| *Trifolium microcephalum* | littlehead clover | July 1, 1806 | mouth of Lolo Creek, Missoula County |
| *Zygadenus elegans* | mountain death-camas | July 7, 1806 | Lewis and Clark Pass, Lewis and Clark County |

arrow-leaved balsamroot (photo: Dean Biggins)

scarlet globemallow (DFWP photo: Mike Aderhold)

tion relied, since he knew such information would aid future travelers to the region. In his description of the "white apple" with the turniplike root, he described how the Plains Indians used the roots—in the fresh state, roots were either boiled with meat or roasted over hot coals. Flour made from dried roots was used to thicken stews and soups. Lewis ended his diary notation by describing the "white apple" as a tasteless, insipid food, yet one that was relatively nutritious. Expedition member John Colter apparently was an attentive listener. After his discharge from the expedition, he subsisted on "white apple" roots for about a week after fleeing hostile Indians.

A tasty currant discovered near the Gates of the Mountains prompted Lewis to note: "...this currant, would be preferred at our markets to any currant now cultivated in the U. States." In reference to the wild (or nodding) onion (*Allium cernuum*) found in the Three Forks area, Lewis wrote: "...a valuable plant inasmuch as it produces a large quantity to the squar foot and bears with ease the rigor of this climate, and with all I think it as pleasantly flavored as any species of that root I ever tasted."

lufted evening primrose (photo: Jim Romo)

When the expedition camped near the headwaters of the Beaverhead River in the Big Hole Valley on Aug. 22, 1805, George Drouillard encountered a small band of Shoshone. After a minor altercation in which one of the Indians attempted to steal his rifle, the Indians fled, leaving behind their baggage. Lewis inspected it and found:

> ...a couple of bags wove with the fingers of the bark of the silk grass [yucca?] containing each about a bushel dryed service berries some ch[ok]e cherry cakes and about a bushel of roots of three different kinds dryed and prepared for use which were folded in as many parchment hides of buffaloe...one species [bitterroot] of the roots were fusiform abo[u]t six inches long and about the size of a mans finger at the larger end tapering to a small point. this root is frequently eaten by the Indians either green in it's dryed state without the preperation of boiling.

When the explorers re-entered Montana on their return trek in 1806, Lewis collected a specimen of bitterroot on July 1, at the mouth of Lolo Creek near Missoula. In later years, a noted British botanist, Frederick Pursh, examined Lewis' plant collection and scientifically named the bitterroot *Lewisia rediviva* in honor of Meriwether Lewis. The radiant beauty of the bitterroot would at a later date lead to its selection as Montana's state flower and it would also lend its name to a mountain range, a river, and a valley.

Lewis devoted a fair amount of space in the journals to those plants with possible economic value. Near Three Forks, he discovered a species of flax, *Linum lewisii,* and wrote "...might on experiment yeild good flax." During the westward trek, Lewis collected many different varieties of seeds which were carried

## Plants Observed and Described by Lewis in Montana for the First Time But Not Collected

| Scientific Name | Common Name | Date | Location |
|---|---|---|---|
| *Betula occidentalis* | western paper birch | Aug. 3, 1805 | vicinity of Jefferson River, Three Forks area, Madison County |
| *Cirsium foliosum* | elk thistle | July 23, 1805 | Broadwater County |
| *Cypripedium montanum* | mountain ladys-slipper | June 30, 1806 | Lolo Hot Springs area, Missoula County |
| *Mamillaria missouriensis* | yellow pincushion cactus | July 26, 1806 | Three Forks area, Broadwater County |
| *Opuntia fragilis* | brittle prickly pear | May 20, 1805 | just below mouth of Musselshell River, Garfield County |
| *Pinus flexilis* | limber pine | May 31, 1805 | mouth of Eagle Creek, east of Virgelle, Chouteau County |
| *Populus angustifolia* | narrowleaf cottonwood | June 12, 1805 | between Marias River and Great Falls, Chouteau County |
| *Potentilla fruticosa* | shrubby cinquefoil | June 5, 1806 | west of Lewis and Clark Pass, Missoula or Powell counties |
| *Ribes cereum* | squaw currant | June 18, 1805 | Great Falls area, Cascade County |
| *Tanecetum nuttallii* | Nuttall tansy | June 6, 1805 | vicinity of Teton River, Chouteau County |

back and planted, mostly in the Philadelphia area. Some, such as currants, proved quite successful.

As instructed by President Jefferson, Lewis paid close attention to "the dates at which particular plants put forth their flowers...." Although he was unaware of it, he was dabbling in the science of phenology and recording some valuable biological information (phenology is a branch of science dealing with the relationships between weather and periodic biological phenomena). Examples of his attentiveness include:

June 3, 1805, vicinity of Marias River—"Saw the Yellow and Red currants, not yet ripe. Also the goosberry which begins to ripen. the wild rose which grows here in great abundance in the bottoms of all these rivers is now in full bloom."

June 25, 1805, Great Falls area—"Among the vegetable productions we observe a species of wild rye which is now heading."

July 15, 1805, vicinity of the Smith River—"We find the prickly-pear, one of the greatest beauties as well as the greatest inconveniences of the plains, now in full bloom."

June 30, 1806, vicinity of Lolo Hot Springs—"I also met with the plant in blume which is sometimes called the lady's slipper or mockerson flower. it is in shape and appearance like ours only that the corolla is white, marked with small veigns of pale red longitudinally on the inner side."

Lewis also displayed a keen interest in documenting specific plants utilized by various wildlife species:

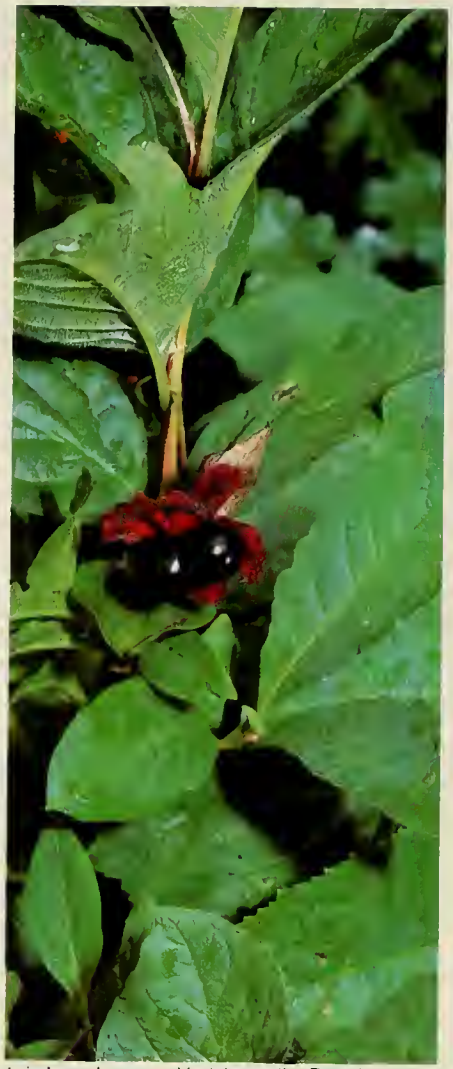
April 26, 1805, vicinity of Fort Union—"...the open bottoms border on the hills, and are covered in many parts by the wild hyssop [sagebrush] which rises to the hight of two feet. I observe that the Antelope, Buffaloe Elk and deer feed on this herb; the willow of the sandbars also furnish a favorite winter food to these anamals as well as the growse, the prcupine, hare, and rabbit."

July 2, 1805, vicinity of Great Falls—"I have frequently seen the nests of these [pack] rats in clifts of rocks and hollow trees but never before saw one of them. They feed very much on the fruit and seed of the prickly pear; or at least I have seen large quantities of the hulls of that fruit lying about their holes and in their nests."

In documenting the narrowleaf cottonwood (*Populus angustifolia*) in the Great Falls area and comparing it with the plains cottonwood (*Populus deltoides*), Lewis remarked: "the beaver appear to be extremely fond of this tree [*P. angustifolia*] and even seem to select it from the other species of Cottonwood [*P. deltoides*], probably from it's affording a deeper and softer bark than the otheer species...."

While the Lewis and Clark journals do not provide a complete picture of plant communities, they do underscore that whether we are talking about historical or present times, dynamic and competitive factors in the environment are constantly at work. Lewis' comments on plants represent a single frame from a motion picture film—an arrested moment in the long and complex history of living things. For example, on numerous occasions historians have written with descriptive rhetoric of the "flowing ocean of pristine grasses" and of the "tall, limber grasses" that would "bend under a passing horse's belly." Thus, a reader is left with the impression that Montana and other parts of the Great Plains once consisted of an endless sea of tall grasses rippling under capricious winds. Lewis was the first to document that such ecological impressions were not necessarily correct. Reflect-

mountain ladys-slipper (photo: Steve Wirt)



twin-berry honeysuckle (photo: Jim Romo)

elephanthead pedicularis (photo: Dean Biggins)

ing on a vegetative landscape near Great Falls, he wrote: "immence quantities of small grasshoppers of a brown colour in the plains, they no doubt contribute much to keep the grass as low as we find it which is not generally more than three inches...."

During their painstaking portage around the Great Falls of the Missouri River, Lewis noted that the spiny beds of prickly pear added another dimension to their growing list of trials. Their Great Falls portage cut across one of many buffalo migration routes they encountered during their journey through the Plains country. The abundance of prickly pear in such areas served as mute testimony that overgrazing was but one of many factors operating in plant successional stages. Contrary to what is commonly believed today, overgrazing in certain areas of Montana occurred long before the first Texas Trail herds rolled in.

In Gerald S. Snyder's "In the Footsteps of Lewis and Clark," there is an Olaf Seltzer plate of Meriwether Lewis perched on a lofty bluff bordering the Missouri River. With spyglass in hand, Lewis gains his first view of the Rocky Mountains. Every time I look at the painting, I reflect on the panorama of the landscape and wonder if Lewis' thoughts ever touched on the subject of plant distribution. We know that ecological fitness furnishes the clue to many of the problems of plant distribution, but historic forces of geology, climatology, and evolution must be included to explain many of the large-scale patterns of distribution. Despite the information void in the natural sciences for his era, did Lewis put together a similar pattern for the distribution of the plants he encountered?

What was the most useful plant the Corps of Discovery utilized during the arduous trek across the continent? I would have to agree with Paul Russell Cutright, author of numerous Lewis and Clark pieces, that the cottonwood ranked as number one. In "Lewis and Clark and Cottonwood," Cutright wrote: "Lewis had said in the beginning that he knew of no useful purpose of cottonwood except for building pirogues. Since then he and the other explorers had spent one entire winter in a cottonwood bastion. They had sat on cottonwood chairs, at cottonwood tables, eating food cooked over cottonwood fires. Cottonwood had made wagons possible and portages successful. Heat from blazing cottonwood had driven cold away. The leafy tops of cottonwood trees had provided shelter. The wood of this *Populus* had gone into the making of benches and shelves, paddles, masts and steering poles, axletrees, coupling tongues and hounds, and who knows what else?"

Conversely, the most troublesome plant was the prickly pear cactus. On July 24, 1805, Lewis wrote: "Our trio of pests still invade and abstruct us on all occasions, these are the Musquetoes eye knats and prickley pears, equal to any three curses that ever poor Egypt laiboured under, except the Mahometant yoke."

# What Happened to Lewis' Plant Specimens?

All of the plants collected by Meriwether Lewis on the westward journey in 1805, between Fort Mandan and the Great Falls area, were packaged and cached underground, along with animal and bird skins and other objects too bulky to transport. When the caches were opened on the return trip, practically all of the specimens had been ruined by flood waters. The losses completely destroyed months of dedicated effort and partially defeated Lewis' botanical objectives.

At the end of the expedition, Lewis' plant specimens were made available to Frederick Pursh, an English botanist who was in Philadelphia working on North America's flora. After examining the Lewis collection, Pursh found most were previously undocumented. In 1811, Pursh went to London to complete his work, taking with him a number of Lewis' specimens, especially those new to him and which he wanted to further study. After completing *"Flora Americae Septentrionalis* ("Plants of North America") in 1814—which included 124 plants collected by Lewis—Pursh turned the Lewis specimens over to the A.B. Lambert Herbarium of the British Museum. In 1842, many of the specimens were purchased at public auction by Edward Tuckerman, an American botanist, and in 1856 were presented to the Academy of Natural Sciences in Philadelphia.

Those specimens that Pursh had not taken with him remained in custody of the American Philosophical Society. Here, they stayed out of sight and out of mind for nearly a century. In 1896, Thomas Meehan, a botanist at the Academy of Natural Sciences, began searching for the almost forgotten collection and found it at the American Philosophical Society. Most were in fair shape, but insects had raised havoc with others and only fragments of the original plants remained. These specimens were loaned to the Academy of Natural Sciences, where they now reside.

*Betula occidentalis*

According to Paul Russell Cutright, professor of biology at Beaver College in Glenside, Penn., there are 216 herbarium sheets in the Lewis and Clark Herbarium of the Academy of Natural Sciences. Many, however, are duplications and Cutright estimates that because of duplications and fragmentary specimens in which identifications are questionable, the actual number of species ranges between 165 and 170. Of these, 70 to 75 were new to science when Lewis collected them. Twenty-eight of the specimens were collected in Montana (see chart).

More than 176 years have passed since the Lewis and Clark expedition left Montana. What were some of their lingering contributions?

- Many plants described and collected in Montana were new to science—this was probably Lewis' most significant botanical contribution. Twenty-eight of the plants he collected in Montana now reside in the Lewis and Clark Herbarium of the Academy of Natural Sciences in Philadelphia. Unfortunately, Lewis received little recognition for many of his discoveries because, in many instances, herbarium specimens could not be produced to verify his descriptions. He attempted to collect as many species as possible, but inadequate preparation, preservation, and methods of transportation destroyed many of the specimens (see sidebar).
- Lewis provided the first reliable description of various vegetative landscapes that would give future travelers a focus in establishing claim to certain geographical areas of Montana.
- Lewis' observations extended the range of some plants previously known only in the eastern United States—for example, the green ash (*Fraxinus pennsylvanica*).
- Lewis was the first to initiate phenological observations through which researchers would later link dates of bloom with various wildlife phenomena, especially interesting in the Rocky Mountain region where spring and summer ascend the slopes.
- Lewis provided valuable information on edible plants which the Indians and expedition members relied on as staples and which would be important to future travelers in the region.
- Lewis' detailed botanical descriptions had a stimulating impact on latter-day scientific studies in diverse disciplines. He paved the way as a brilliant example in the art of observation and note-taking.
- Lewis' documentations, although not spelled out in modern-day ecological terms, suggested that the distribution of certain plants—such as sagebrush—demonstrated a flexible adaptability to a wide range of soil and climatic conditions.

As the Corps of Discovery's naturalist, Meriwether Lewis enriched the biological archives of a growing nation. Few people can appreciate the significance of his contributions. The closer one examines the botanical and zoological portions of the journals, the more enlightening they appear. Time and circumstances have dulled many of the expedition's accomplishments. As a result, one tends to forget the numerous hardships they encountered in achieving their objectives.

On foot, on horseback, and by canoe, they pushed over rugged mountain ranges, across seemingly endless plains, through dense forests, and against powerful currents, cottonwood snags, and raging waters. They endured drudgery and fatigue, as well as sickness, agonizing aches and pains, numbing cold, driving rain and scorching sun, deadly rattlers, charging grizzlies, irritating mosquitoes, and prickly pear.

Through all of this, Lewis—the dedicated botanist—superbly fulfilled his obligations to the scientific world. ■

HUDD